Economic Impact of Oil and Gas Industry In British Columbia

Abha Bhargava
Brian Bowers
Govinda Timilsina
Janna Poliakov
The Canadian Energy Research Institute

In Partnership with
Rob McManus
R. McManus Consulting Ltd.

&

Ernie Stokes
The Centre for Spatial Economics

Prepared for:
British Columbia Energy and Mines

November 2004

105-06709/

Table of Contents

EXECUTIVE SUMMARY ..... **I**

ES.1 Study Background and Objectives I
ES.2 Study Methodology I
ES.3 B.C. Oil and Gas Model II
ES.4 The Macroeconomic Impact Models II
ES.5 Economic Indicators for the Oil and Gas Industry II
ES.6 Total Impact of the Oil and Gas Industry on the Economy IV
ES.7 Employment in the Oil and Gas Sector VI
ES.8 Expenditure Analysis VII
ES.8.1 Survey Methodology for Expenditure Analysis vii
ES.8.2 Analysis of Aggregate Industry Expenditure Patterns vii
ES.8.3 Estimating the Value of Expenditures viii
ES.8.4 Analysis of Producer Expenditures on Exploration and Production ix
ES.8.5 Analysis of Service Sector Expenditures on Upstream Oil and Gas Activity x
ES.8.6 Summary xii

1. INTRODUCTION **1**

1.1 Background 1
1.2 The Objectives of the Study 1
1.3 Study Deliverables 2
1.4 The Study Methodology 2
1.5 Models Used in the Study 3
1.5.1 Macroeconomic Impact Models 3
1.5.2 B.C. Oil and Gas Model 4
1.5.3 The Model Linkages 5

2. ECONOMIC CONTRIBUTION OF THE INDUSTRY TO BRITISH COLUMBIA **6**

2.1 Economic Indicators for the Oil and Gas Industry 6
2.2 Macroeconomic Modelling Considerations 10
2.2.1 Investment Expenditures 10
2.2.2 Production Inputs and Value Added 10
2.2.3 Labour Data in the Macroeconomic Impact Models 12
2.3 Identifying the Economic Contribution of the Oil and Gas Industry 13
2.3.1 Economic and Fiscal Contribution 15
2.3.2 Quantifying the Economic Contribution of the Industry 16
- British Columbia 16
- Northeast Region 20
- Summary Measures of Oil and Gas Impacts: GDP Multipliers 21

3. SURVEY OF THE OIL AND GAS INDUSTRY EXPENDITURES **25**

3.1 Data Requirement 25
3.1.1 Primary Data Collected for the Study 25
3.1.2 Interpretation of Expenditure Survey Results 26
3.2 Analysis of Expenditure Survey Data 27
3.2.1 Analysis of Aggregate Industry Expenditure Patterns 28
3.2.2 Estimating the Value of Expenditures 31
3.2.3 Analysis of the Producer Expenditures 31
3.2.4 Analysis of Service Sector Expenditures 34
3.3 Summary 36
3.4 Next Steps 37

APPENDIX 1: MAP OF NORTHEAST REGION OF BRITISH COLUMBIA **38**

APPENDIX 2: MACROECONOMIC GLOSSARY **39**

List of Figures

Figure ES.1 Share of Gross Domestic Product Directly Attributable to the Oil and Gas Industry, B.C. and the Northeast Region (%) iii
Figure ES.2 Flow of Oil and Gas Sector Expenditures in B.C., 2002 viii
Figure ES.3 Jurisdictional Shares of Direct Expenditures by All Oil and Gas Producers, 2002 x
Figure ES.4 Jurisdictional Shares of Direct Expenditures by All Service and Supply Companies, 2002 xi
Figure 1. Methodological Framework 3
Figure 2. Model Linkages 5
Figure 3 Oil and Gas Industry Share of Gross Domestic Product, B.C. and the Northeast Region (%) 7
Figure 4. GDP by Economic Sector in Northeast B.C. - 2002 8
Figure 5. Oil and Gas Industry Share of Non-Residential Construction Investment, B.C. (%) 9
Figure 6. Oil and Gas Industry Royalty Share of Provincial Revenues, B.C. (%) 10
Figure 7 Oil and Gas Investment and Gross Output ($1997 Millions) 14
Figure 8 Expenditure Impact on B.C. Real GDP (Percentage Difference from Base Case) 16
Figure 7. Grouping of Oil and Gas Companies for the Purpose of Data Collection 25
Figure 8. Overall Survey Methodology 26
Figure 9. Flow of Oil and Gas Sector Expenditures in B.C., 2002 29
Figure 10. Jurisdictional Shares of Directly Hired Labour and Purchased Goods Sourced by Oil and Gas Producers, 2002 (Aggregated) 33
Figure 11. Jurisdictional Shares for Labour and Good and Service Expenditures of Service and Supply Companies (2002) (Aggregated) 35

List of Tables

Table ES.1 Oil and Gas Industry Performance, 1996-2002 ii
Table ES.2 Oil and Gas Industry Impacts: Gas Well Development and Extraction v
Table ES.3 Future Oil and Gas Industry Impacts 2002 Oil and Gas Investment vi
Table ES.4 Direct Employment in Oil and Gas Related Labour Force Categories in British Columbia - 2003 vi
Table ES.5 Analysis of Total Expenditures for Oil and Gas Producers, 2002 ix
Table ES.6 Activity Shares of Directly Hired Labour and Directly Purchased Goods and Services of the Oil and Gas Producers, 2002 x
Table ES.7 Analysis of Total Expenditures for All Service and Supply Companies, 2002 xi
Table 1. Oil and Gas Industry Performance, 1996-2002 ($1997 Millions except where noted) 6
Table 2. Inputs Required to Oil and Gas Industry Output (%) 11
Table 3. Direct Employment in Oil and Gas Related Labour Force Categories in British Columbia - 2003 13
Table 4 Key Indicator Impact Table, B.C. (Percentage or Level Difference from Base Case) 18
Table 5 Industry Impact Table, B.C. (Percentage or Level Difference from Base Case) 18
Table 6 Fiscal Impact Table, B.C. (Percentage or Level Difference from Base Case) 19
Table 7 Key Indicator Impact Table, Northeast Region (Percentage or Level Difference from Base Case) 22
Table 8 Industry Impact Table, Northeast Region (Percentage or Level Difference from Base Case) 22
Table 9 Summary Impact Measures: Development Scenario Multipliers 23
Table 10 Future Oil and Gas Industry Impacts 2002 Oil and Gas Investment 24
Table 10. Analysis of Total Expenditures for Oil and Gas Producers, 2002 32
Table 11. Activity Shares of Directly Hired Labour and Directly Purchased Goods and Services of the Oil and Gas Producers, 2002 33
Table 12. Analysis of Total Expenditures for Service and Supply Companies, 2002 35

Acknowledgements

The consultants would like to acknowledge the wide support from the oil and gas sector companies for their participation in the collection of the primary data and their insights into the operation of the industry in British Columbia. The support and assistance from the industry associations including the Canadian Association of Petroleum Producers (CAPP), the Canadian Association of Oil Well Drilling Contractors (CAODC), the Petroleum Services Association of Canada (PSAC) and the Canadian Association of Geophysical Contractors (CAGC) also needs to be recognized for their facilitation and pursuance.

The authors would also like to acknowledge the financial and staff time support from the Ministry of Energy and Mines. Special thanks are due to the project-in-charge Ms. Linda Bates, Ms. Ines Piccinino and Mr. David Molinski for their continuous guidance and timely support all through the project.

The authors of the study would also like to acknowledge the guidance, careful review and insights provided by Dr. Brian Scarfe especially pertaining to methodology development.

Executive Summary

ES.1 Study Background and Objectives

The oil and gas industry[1] is a powerful economic force in British Columbia with about 100 active oil and gas producers. Increased exploration and production activities for natural gas are having an important impact on the British Columbia economy, and in particular, on the economy of the Northeast region of the province where the bulk of this activity is taking place (see Map in Appendix 1). Moreover, not only has there been a noticeable increase in natural gas activity over the past few years, but technical studies suggest large potential gas supply that will enable continued strong activity in the future.

This study (the first of its kind to be undertaken for the oil and gas industry in British Columbia) was commissioned to provide the Ministry of Energy and Mines with the following information on the upstream oil and gas industry:

(a) an analysis of the contribution of oil and gas sector activity to the performance of the regional Northeast and provincial economy using macroeconomic modelling; and

(b) an analysis of the industry expenditures on goods, services and labour sourced from within and outside of British Columbia.

The project was awarded to the Canadian Research Institute (CERI) and the Centre for Spatial Economics (C4SE) through a competitive bid process.

ES.2 Study Methodology

In developing the methodology for this study, CERI and C4SE:

- accessed published (i.e. secondary) data from a variety of sources,
- gathered unpublished (i.e. primary) data on firm-level expenditures , while maintaining confidentiality protocols, and
- constructed and utilized models to simulate provincial oil and gas activity and estimate regional and provincial economic impacts of such activity.

The firm-level expenditure decisions are measured through a survey of oil and gas producers and service and supply companies. The industry level analysis utilizes

[1] Throughout this study, "oil and gas industry" refers to "oil and gas extraction."

the B.C. Oil and Gas Model, and it examines the drivers of activity, including the geologic potential, energy commodity prices, and fiscal parameters. The economy-wide analysis uses macroeconomic impact models (macro models) to estimate the economic impacts of oil and gas industry activity on the provincial and regional economy.

ES.3 B.C. Oil and Gas Model

This model examines the response of the oil and gas industry to various fiscal, market and geologic factors. The B.C. Oil and Gas Model ultimately produces projections of production, investment and other variables that are inputs to the macroeconomic impact models.

ES.4 The Macroeconomic Impact Models

To analyze the economic contributions of the oil and gas industry, two macroeconomic impact models were created: one for the province and one for the Northeast region. These are multi-sector macroeconomic models that take into account interactions among industries, households, non-residents, and governments. The models are calibrated to Statistics Canada's economic and demographic data along with some data estimated for the Northeast region model by the Centre for Spatial Economics.

It should be noted that there are no links between the Northeast model and the model for the province as a whole. That is, changes that occur in the provincial model do not automatically impact the Northeast region model and vice versa. Neither is it possible to subtract Northeast regional indicator values from those for the province to estimate "rest-of-province" impacts.

ES.5 Economic Indicators for the Oil and Gas Industry

The performance of key economic indicators used to assess the direct economic impacts for the oil and gas industry since 1996 is shown in Table ES.1.

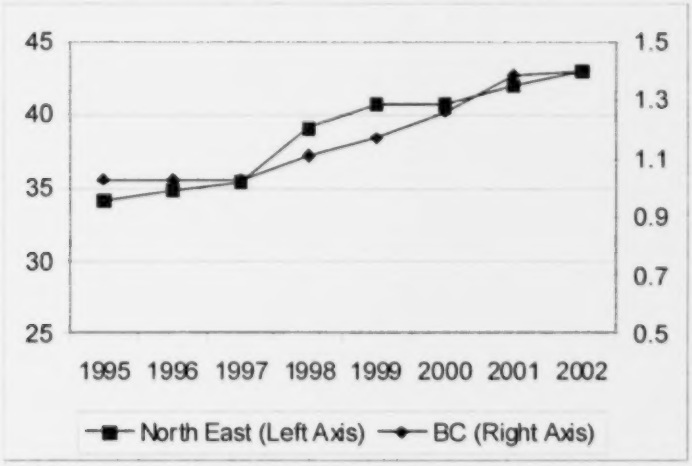
Table ES.1
Oil and Gas Industry Performance, 1996-2002

Variable/Year	1996	1997	1998	1999	2000	2001	2002
GDP ($1997 Millions)	1043.1	1080.2	1176.2	1275.4	1431.8	1590.4	1637.8
Investment ($1997 Millions)	1055.5	1293.7	1302.1	941.7	1496.1	2455.7	1571.7
Gas Royalties (Current $)	131.7	174.8	180.1	293.7	876.6	1131.8	787.0
Oil Royalties (Current $)	72.9	79.6	62.7	76.1	136.4	110.7	107.0

Source: Statistics Canada and B.C. Government

As can be seen from the table, the production of the industry, as measured by real GDP (Gross Domestic Product), has increased significantly since the mid 1990s. The significance of the oil and gas industry as measured by GDP [2]can be seen from Figure ES.1. This figure shows the share of real GDP accounted for by the oil and gas industry since 1995 in the province as a whole (as measured on the right axis) and the Northeast region (as measured on the left axis).

Figure ES.1
Share of Gross Domestic Product Directly Attributable to the Oil and Gas Industry, B.C. and the Northeast Region (%)



Source: Statistics Canada and the Centre for Spatial Economics

The share of real GDP directly attributable to the oil and gas industry in the Northeast region has increased from about 34% in 1995 to 44% in 2002[3]. For the province as a whole, this share has risen from about 1.0% to 1.4% over the period.

---

[2] GDP refers to the value of production that occurs in a defined jurisdiction regardless of who actually undertakes the activity or their place of origin. Real GDP adjusts GDP for the effects of inflation.

[3] Gross Domestic Product (GDP) estimates for the Northeast region are not available and they were calculated using a "provincial productivity" approach. Basically, productivity (sector GDP divided by employment in the sector) for each economic sector is calculated for the province and, using the regional employment information from the Labour Force Survey, it is possible to calculate a regional GDP for the Northeast. Adjustments have been made to the productivity approach to consider the fact that a proportion of workers in the oil and gas sector in British Columbia does not live in the province (they are not B.C. residents). Comparing productivity figures in the oil and gas extraction in British Columbia with Canadian averages and Alberta averages, productivity was adjusted to account for these workers that "produce" in British Columbia (thus contributing to British Columbia's GDP) but do not reside in British Columbia.

Other indicators also illustrate the significance of the oil and gas industry to the provincial and regional economies. For example, the share of oil and gas investment (as a proportion of total investment in the province) has risen from about 5% in the early 1990s to peak at 14% in 2001, consistent with growing activity in the region.

The importance of the industry to non-residential construction investment is even more significant; in 2001, over 40% of non-residential construction investment in the province was attributable to the oil and gas industry.

Similarly, the industry's impact on provincial government revenues is very important. Natural gas royalties have risen from about $75 million in 1992 to over $1 billion in 2001. As a percentage of total provincial revenues[4], oil and gas royalties have risen from less than 1% in 1995 to almost 6% in 2001.

ES.6 Total Impact of the Oil and Gas Industry on the Economy

The discussion above provides an indication of the direct impact of the industry on the economy as measured by GDP and investment. However, this information does not provide an estimate of the total impact of the industry on the performance of the provincial economy, because it does not take into account the interactions of the industry's activities with the rest of the economy and the provincial government.

The main question of interest in considering the impact of the industry on the economy is: What is the impact on the economy of an additional $1 of oil and gas investment in natural gas well development and extraction? The approach adopted to answer this question is to create a scenario of the performance of the economy with higher oil and gas investment and compare it against one that that does not contain such an increase. The increase in investment adopted depicts the typical expenditure pattern for a tied well including its development and the time profile of its production until it is depleted.

The investment and production values for this scenario were created using the natural gas model developed by CERI for B.C. Ministry of Energy and Mines. A change in drilling initiatives was fed into the model to produce an increase in development expenditures and production for the resulting wells over the life of the wells. These results, in turn, were then fed into the macroeconomic impact models. The development expenditures take place in 2004, which leads to gas production starting in 2005 and continuing to 2013 when the associated wells are depleted. Maintenance investment associated with gas extraction is assumed to occur over this period.

---

[4] Measured on a Provincial Economic Accounts basis.

The results of the impact study are shown in Table ES.2. They suggest that for every $1 of oil and gas investment for well development and gas extraction during the life of the well, $2.5 of GDP are created for the province as a whole and $1.3 for the Northeast region (in 1997 dollars).

Table ES.2
Oil and Gas Industry Impacts:
Gas Well Development and Extraction

Indicator	B.C.	Northeast B.C.
GDP (per $ 1 additional 1997 dollar of investment)	2.50	1.29
- Consumer Expenditures	1.36	0.79
- Residential Investment Expenditures	0.33	0.16
- Non-residential investment Expenditures	1.40	1.08
- Net exports	-0.65	-0.88

Source: CERI/C4SE

The industries that benefit the most from the well development and production expenditures made by the oil and gas industry are oil and gas services and construction.

To get some idea of the magnitude of current oil and gas investment on the economy, the ratios in Table ES.2 are applied to the level of oil and gas industry investment in 2002, which is shown in Table ES.1. Under the assumption that this investment of about $1.6 billion 1997 dollars is used for well development and extraction, the values for GDP and the other indicators associated with investment are shown in Table ES.3.

As can be seen from the table, the investment made by the industry in 2002 will result in an additional $3.9 billion of GDP for the province as a whole and $2.0 billion in the Northeast region over the period 2002-2011. For the province as a whole, this increase is 3.0% of current GDP, while for the Northeast region it is about 47.0% of current GDP.

Table ES.3
Future Oil and Gas Industry Impacts
2002 Oil and Gas Investment

Indicator	B.C.	Northeast B.C.
GDP (per $ 1.6 billion 1997 dollar of investment)	3,933	2,030
- Consumer Expenditures	2,144	1,243
- Residential Investment Expenditures	525	256
- Non-residential investment Expenditures	2,193	1,691
- Net exports	-1,016	-1,378

Source: CERI/C4SE

It is clear from these results that the oil and gas industry has had and will continue to have an important impact on the economy of British Columbia. This impact is particularly important for the Northeast region of the province where the bulk of oil and gas activity is taking place.

ES.7 Employment in the Oil and Gas Sector

An important sub-product of this study was the determination of direct employment in the oil and gas sector in 2003, including extraction and associated activities. For 2003, and based on a special request to Statistics Canada, total employment in oil and gas related Labour Force categories was estimated in 11,400 people, as seen in Table ES. 4.

Table ES.4
Direct Employment in Oil and Gas Related Labour Force Categories in British Columbia - 2003

Sector	People working in 2003
Oil & Gas Extraction	2,600
Support Activities for Mining and Oil and Gas Extraction	4,200
Pipeline Transportation	300
Petroleum and Coal Products Manufacturing	2,100
Natural Gas Distribution	2,200
Total Direct Employment in Oil and Gas related activities in British Columbia	**11,400**

Source: Centre for Spatial Economics based on Statistics Canada Labour Force Survey.

ES.8 Expenditure Analysis

The purpose of this analysis is to look at allocation of expenditures by the industry across goods, services and labour utilized to undertake upstream activity in B.C. The jurisdictional source of such expenditures (i.e. within Northeast B.C., from other B.C. and outside of B.C.) was also identified. Since activities of oil and gas companies vary across the industry, companies were segregated into oil and gas producers, and service and supply companies. The latter category was further divided into three subcategories based on the type of services provided: drilling companies, seismic companies (i.e. geological and geophysical), and all other service and supply companies.

ES.8.1 Survey Methodology for Expenditure Analysis

The primary data required by the study were collected through a survey, supplementary interviews and discussions. Separate analyses were carried out for each of the producers and service sector company categories, and results then were aggregated for the entire industry.

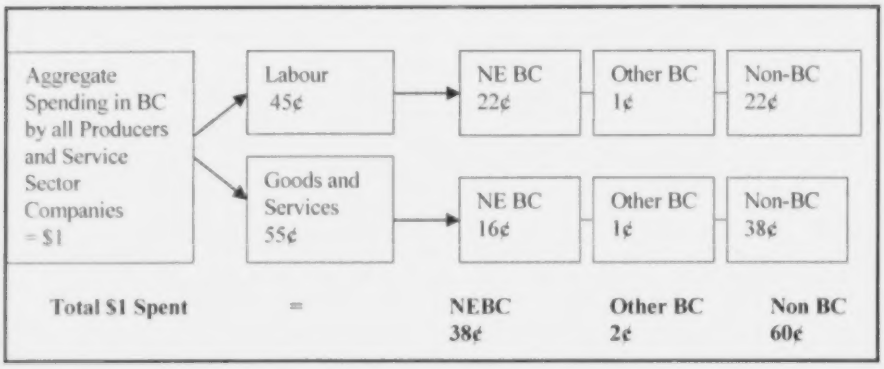
All types of producer companies (i.e., large, mid-sized and small) were represented in the survey, as were all major drilling, seismic and other service and supply companies operating in the Northeast region of British Columbia (e.g. civil engineering companies, well completion and testing companies, oil and gas tubular goods companies, environmental services companies and trucking companies).

Oil and gas producers responding to the survey, account for a significant proportion of regional activity and therefore expenditures (i.e. 43% of the total production in the 1st Quarter of 2003). In the case of service and supply companies, 20 companies participated in the study out of a representative sample of 45 companies, for a relatively high response rate of 44%.

ES.8.2 Analysis of Aggregate Industry Expenditure Patterns

Figure ES.2 summarizes the oil and gas sector spending across categories and across jurisdictions. The figure represents all spending across all companies (producers and service and supply companies) and jurisdictions. If $1 is spent in the oil and gas sector in B.C., 45¢ is on labour and 55¢ is on goods and services. Of the 45¢ labour expenditures, 23¢ is spent on labour sourced within the province and the remaining 22¢ is spent outside of the province. Of the 55¢ spent on goods and services, 17¢ is spent on goods sourced within the province, with the remaining 38¢ spent outside the province. Roughly 60% of total industry expenditures are made outside of the province, but represent investment by producers made for the purposes of undertaking exploration and production in British Columbia.

Figure ES.2 Flow of Oil and Gas Sector Expenditures in B.C., 2002



Note that for purposes of this study, labour sourced from inside the province or region refers to:

- employees directly employed annually or seasonally in production, operation, and facility construction activities undertaken by the oil and gas producers; and
- employees hired annually or seasonally by drilling, seismic and other service and supply companies to conduct work in B.C.

Similarly, local purchases of goods and services are defined as those bought through local Northeast (or provincial) vendors, although the actual goods themselves may have been manufactured outside the region.

It is not possible to state categorically how much of this expenditure on goods, labour and services sourced within B.C. stays within the province. For example, if pipe or heavy equipment is bought through a local vendor, it is considered to be a local expenditure. But if such goods are actually manufactured in another province or the U.S., then much of the economic benefit will actually leave the province to the original manufacturer. This is not a situation unique to B.C.; it is simply a factor of operating in an open economy

ES.8.3 Estimating the Value of Expenditures

For reasons of corporate confidentiality, actual expenditure (budget) data are not released in the study, and only the relative proportion of expenditures are illustrated. However, by applying the relative expenditure proportions to industry expenditure figures, it is possible to estimate the value of oil and gas industry expenditures in B.C. in 2002. The Canadian Association of Petroleum Producers reports that approximately $3.4

billion[5] was spent by the B.C. oil and gas industry in 2002. Results of this study would suggest that 40% of this $3.4 billion (i.e. about $1.4 billion) was spent on labour, goods and services sourced within the province, while the remaining $2 billion was spent on labour, goods and services sourced outside the province.

ES.8.4 Analysis of Producer Expenditures on Exploration and Production

As shown in Table ES.4, a significant component (24%) of producer expenditures are budgeted for directly purchased equipment such as compressors, pump jacks, steel pipe for pipelines, dehydrators and other similar equipment that needs to be installed to produce and transport oil and gas in B.C. Much of this equipment is manufactured in Ontario, Europe, Asia and elsewhere. Consequently, the benefits of some oil and gas investment decisions made in Canada are global in nature.

About 15% of producer expenditures are also budgeted for directly hired labour, including salaries and administrative costs for geologists, engineers, accountants, operations personnel, etc. who work in both companies' head offices and in field locations where their oil and gas facilities are located. This is typically the smallest of the budgeted categories for direct oil and gas expenditures.

However, the majority of producer spending (61%) is for work undertaken by third-party service and supply companies, including seismic, drilling, pipeline and construction companies that provide services in B.C. and the rest of Canada (see ES.5, Analysis of Service Sector Expenditures).

Table ES.5 Analysis of Total Expenditures for Oil and Gas Producers, 2002

Producers: Average Expenditure Share (%)	
Directly Hired Labour	15%
Directly Purchased Goods and Services	24%
Goods and Services Purchased through Service and Supply Companies	61%
Total	100%

Drilling, production and operation, and facility construction account for almost equal shares in total expenditures on directly hired labour in 2002 (Table ES.6). Drilling and construction of facilities also represent the main expenditures for directly sourced goods and services. Such purchases include surface casing, production casing, tongs, line hangers, drilling bits, drilling mud, reamers, stabilizers and chemicals among other things.

[5] Exclusive of royalties, taxes and land sales revenues.

Table ES.6 Activity Shares of Directly Hired Labour and Directly Purchased Goods and Services of the Oil and Gas Producers, 2002

Activity	Directly Hired Labour	Directly Purchased Goods and Services
Drilling	27%	40%
Production and Operation	28%	18%
Facility Construction	28%	37%
Other *	16%	5%
Total	100%	100%

* Includes land acquisition and rentals, geological and geophysical services etc.

Figure ES.3 shows jurisdictional shares of direct expenditures incurred in 2002 by all oil and gas producers.

Figure ES.3 Jurisdictional Shares of Direct Expenditures by All Oil and Gas Producers, 2002

ES.8.5 Analysis of Service Sector Expenditures on Upstream Oil and Gas Activity

The process undertaken by producers to explore for and produce oil and gas resources involves hundreds of different skills, and a diverse range of large and small service and supply companies that provide these skills. These third-party service and

supply companies include drilling companies, well servicing and testing companies, large environmental firms, equipment suppliers etc. that are normally located in Calgary, Alberta. The smaller service and supply companies (e.g. construction) are located in smaller communities throughout the Western Canadian Sedimentary Basin.

Table ES.6 shows that expenditures by service and supply companies are almost equally distributed between labour and goods and services. Directly hired labour includes office personnel, drilling, service and seismic crews, land clearing personnel, surveyors, truckers etc. Directly purchased goods and services include fuel, equipment and machinery, supplies for repairs, machine parts, office supplies etc.

Table ES.7 Analysis of Total Expenditures for All Service and Supply Companies, 2002

Service and Supply Companies, Average Expenditure Share	
Directly Hired Labour	51%
Directly Purchased Goods and Services	49%
Total	100%

Jurisdictional shares for the labour and goods and service expenditures for service and supply companies are presented in Figure ES.4.

Figure ES.4 Jurisdictional Shares of Direct Expenditures by All Service and Supply Companies, 2002

As illustrated, 63% of the total labour expenditure by service and supply companies occurs within the province (61% from Northeast B.C. and 2% from other parts of B.C.). The remaining 37% of expenditures occur outside of B.C. Of the total expenditures for goods and services, 47% is incurred within the province (45% in Northeast B.C. and 2% in other parts of the province), and the remainder is spent outside the province.

ES.8.6 Summary

The oil and gas industry has, and will continue to have a significant positive impact on the British Columbia economy. It will also very likely continue to be the primary economic driver in the Northeast region of the province.

The discovery, drilling and production of each well generates economic impact since these activities require inputs from many other sectors of the economy at a regional, provincial, national and international level. It is this investment that drives the overall economic activity in B.C. The productivity in the oil and gas industry is relatively high compared to other sectors, reflecting the relatively high level of capital investment and the nature of the industrial operations.

For every $1 of oil and gas investment for well development and gas extraction during the life of the well, $2.5 of GDP are created for the province as a whole and $1.3 for the Northeast region (in 1997 dollars).

About 40% of the investment needed to activate exploration, and production activity in the province is spent within provincial borders. The remainder (60%) represents expenditures on goods and services located outside the provincial borders, but which are integral to activity occurring within British Columbia. Such expenditures include specific types of equipment and services typically located in Calgary and/or Houston, USA. As the industry enters a more mature development phase in British Columbia, with an expansion of permanent local facilities, it is anticipated that local expenditures and employment will rise accordingly.

British Columbia has significant oil and gas resources throughout the province, which offer opportunities for investment and an expansion of the industry. Future exploration and production in these other areas is likely to convey similar positive regional and provincial economic impacts.

1. INTRODUCTION

1.1 Background

Increased exploration and production activities for natural gas are having an important impact on the British Columbia economy, in particular, on the economy of the Northeast region of the province where the bulk of this activity is taking place. Moreover, not only has there been a noticeable increase in natural gas activity over the past few years, but there is potential for continued strong activity in the future.

According to the study titled "Potential Supply and Costs of Natural Gas in Canada" undertaken by the Canadian Energy Research Institute (CERI) in 2003, approximately 2,300 undiscovered and discovered non-associated gas pools would be available in B.C. at a natural gas wellhead price of $5-$6 per Mcf. These pools account for approximately 97% of the total natural gas pools in B.C. and 4% of total natural gas pools in Western Canada. It is estimated that approximately 805 billion cubic metres of reserves of gas may be established with some 18,000 wells drilled from these pools. Such production over the life of the wells, would require $13.5 billion in capital investments and would produce $63.9 billion in revenues including $34.9 billion in royalty and tax revenues to the province. All in all, the natural gas industry in B.C. is well positioned in terms of its geologic potential and is set to generate new investments and future economic growth in the region and province.

1.2 The Objectives of the Study

Oil and gas sector development, particularly gas, is relatively new in B.C. The province would like to see this industry develop to its maximum potential. However, the impacts of the industry are not well understood, and such information is necessary to formulate a solid foundation for government policy and resource development strategies. This study was undertaken as a first step in gaining such information.

The study is intended to analyze the oil and gas industry[6] at both the regional and provincial levels. The specific objectives of the study are:

- To develop models of the economy and the oil and gas sector to analyze impacts of the oil and gas sector activity on the regional and provincial economy of British Columbia.

- To estimate industry expenditures on goods, service and labour required for exploration and production.

---

[6] Throughout this study, oil and gas industry refers to oil and gas extraction.

1.3 Study Deliverables

Consistent with the study objectives, there are two key deliverables for the study.

1. An oil and gas sector activity model and a macroeconomic impact model.

2. Comprehensive reports consisting of the following:

   - Final Report comprising a summary of the estimated contributions of the oil and gas industry to the provincial and regional economies, and industry expenditures of goods, services and labour required to undertake upstream oil and gas activities in B.C.

   - Background material, model and reports summarizing model methodologies, specifications and detailed analytical results.

1.4 The Study Methodology

In developing the methodology for this study, CERI and C4SE:

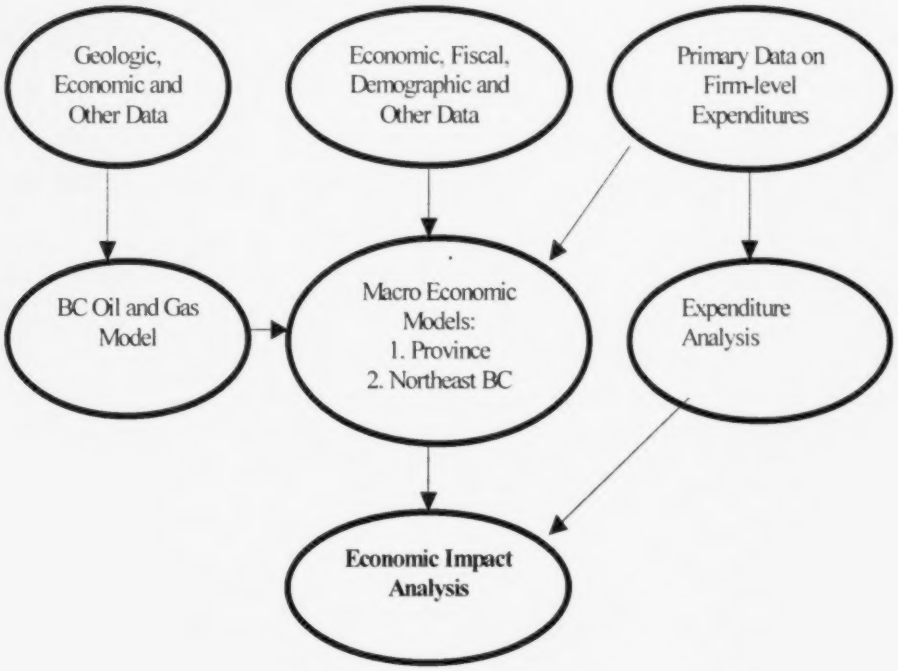
- accessed published (i.e. secondary) data from a variety of sources,

- gathered unpublished (i.e. primary) data on firm-level expenditures , while maintaining confidentiality protocols, and

- constructed and utilized models to simulate provincial oil and gas activity and estimate regional and provincial economic impacts.

The firm-level expenditure decisions are measured through a survey of oil and gas producers and service and supply companies. The industry level analysis utilizes the B.C. Oil and Gas Model, and it examines the drivers of activity, including the geologic potential, energy commodity prices, and fiscal parameters. The economy-wide analysis focuses on understanding the economic impact of the oil and gas sector including its related impacts on other sectors and the overall economy. The basic methodological framework and the linkages amongst the various components of the study are shown in Figure 1.

Figure 1. Methodological Framework


Geologic, Economic and Other Data
Economic, Fiscal, Demographic and Other Data
Primary Data on Firm-level Expenditures
BC Oil and Gas Model
Macro Economic Models: 1. Province 2. Northeast BC
Expenditure Analysis
Economic Impact Analysis

Data collection is the first component of developing decision tools and conducting the impact study. The data is used to: (i) estimate economic leakage; (ii) provide input to the oil and gas sector activity model, and (iii) provide input to the macroeconomic impact model. The simulations from the oil and gas sector activity model and the macroeconomic impact model in association with inputs from the expenditure analysis provide a full range of economic information.

1.5 Models Used in the Study

1.5.1 Macroeconomic Impact Models

The macroeconomic impact models constructed by the Centre for Spatial Economics specifically for this study simulate the economies of the Northeast region and British Columbia as a whole are multi-sector models. These models differ from standard input-output models typically used to estimate economic impacts because they provide a more realistic picture of the workings of an economy. They incorporate an input-output framework with detailed behaviour of households, firms, non-residents, and

governments' interactions as well as estimates of inflation, unemployment and utilization capacity to produce measures of economic output, employment, and government revenues.

Unlike input-output models, the macroeconomic models offer several advantages:

- they show how the economy evolves over time in response to changes in other parts of the economy;
- they can accommodate capacity constraints, inflation and unemployment; and
- they account for changes in the relative prices of goods and services because they include prices, exchange rates, and interest rates that affect industry competitiveness and imports and exports.

Input-output frameworks are very useful for illustrating the inter-industry linkages in an economy, but on their own, provide an incomplete and not very realistic picture of the workings of an economy. For these reasons, a macroeconomic modelling approach was adopted for this study.

The macroeconomic impact models are designed to create future scenarios based on a specific set of assumptions.

1.5.2 B.C. Oil and Gas Model

The B.C. Oil and Gas Model, which was also developed specifically for this study by the Canadian Energy Research Institute, provides key sector inputs to the macroeconomic impact model including investment, production, and production and royalty revenue data. This model generates projections of future oil and gas activity in the Northeast and also examines the response of the oil and gas sector to various fiscal, market and geologic factors. The B.C. Oil and Gas Model was calibrated using CAPP historical drilling data.

The approach for the B.C. Oil and Gas Model is similar to the oil and gas supply model (OGSM) of the US DOE's National Energy Modelling System (NEMS) in its use of alternate modelling philosophies. The model actually simulates four distinct processes of the oil and gas industry through four components or "submodels": the Prospect Model, the Discovery Model, the Activity Model, and the Production Model.

Results of the B.C. Oil and Gas model suggest that if the high commodity prices continue in the future, the oil and gas sector in Northeast B.C. will continue to grow. Based on the model's projections, total gas wells are expected to peak in 2022. These numbers can be compared with the 2001 and 2002 drilling of 772 and 468 gas

wells respectively. The forecast scenario assumes that overall fewer wells will be drilled, but that they will be deeper and exhibit greater productivity levels. Oil wells continue to increase through the forecast period, although the average production per well declines.

Note that this forecast is based on the assumption of an average natural gas price (Henry Hub) of approximately $6 per Mcf in 2001 Canadian dollars. The average West Texas Intermediate (WTI) price for oil is assumed to be $40 per barrel in 2001 Canadian dollars. Also the ultimate potential for gas is assumed to be 50Tcf. Similarly the ultimate potential for oil is assumed to be 150 $10^6 m^3$.

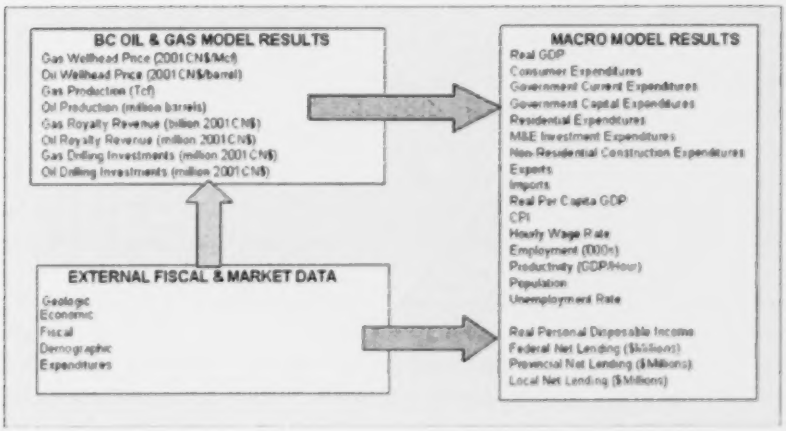
Should actual drilling and production occur at a higher level than what is projected in this study, then a higher level of economic impacts may be expected.

1.5.3 The Model Linkages

The macroeconomic impact models are ideal in capturing the complex interactions of the various sectors and industries in the economy. However, the behavioural details of individual sectors are best left to sector-specific microeconomic models such as the B.C. Oil and Gas Model.

However, to examine the total impact of the oil and gas industry, these microeconomic models need to be inter-linked with the macroeconomic impact model to capture the economy-wide impacts. A soft link is created between the two models, such that the outputs of the oil and gas model (production, investment and royalty revenues) become inputs to the macroeconomic impact model (Figure 2). The macroeconomic impact model then generates estimates of standard economic indicators including GDP, employment, investment and others.

Figure 2. Model Linkages



2. ECONOMIC CONTRIBUTION OF THE INDUSTRY TO BRITISH COLUMBIA

2.1 Economic Indicators for the Oil and Gas Industry

Since 1995, both natural gas production and oil and gas sector investment – adjusted for inflation – have increased 6.5% per year on average, while oil and gas sector employment has grown about 3.5% per year. The performance of key economic indicators for the oil and gas industry since 1996 is shown in Table 1. As can be seen from the table, the production of the industry, as measured by GDP (Gross Domestic product) in $1997 dollars, has doubled since the early 1990s.

Table 1.
Oil and Gas Industry Performance, 1996-2002
($1997 Millions except where noted)

Variable	1996	1997	1998	1999	2000	2001	2002
GDP	1043.1	1080.2	1176.2	1275.4	1431.8	1590.4	1637.8
Investment	1055.5	1293.7	1302.1	941.7	1496.1	2455.7	1571.7
Machinery and Equipment	18.7	29.4	29.6	21.4	34.0	55.8	35.7
Construction	1036.8	1264.3	1272.5	920.3	1462.1	2399.9	1536.0
Gas Royalties ($ Millions Current)	131.7	174.8	180.1	293.7	876.6	1131.8	787.0
Oil Royalties ($ Millions Current)	72.9	79.6	62.7	76.1	136.4	110.7	107.0

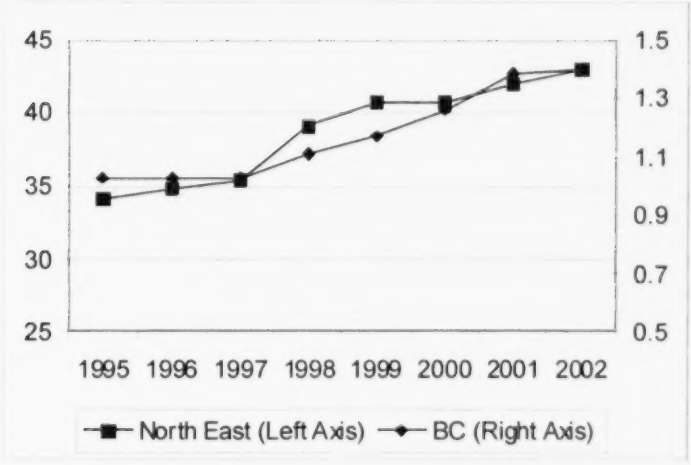
Source: Statistics Canada and B.C. Energy and Mines

The importance of the oil and gas industry to the Northeast region and the province as a whole can be seen from Figure 3. This figure shows the share of real GDP attributable to the oil and gas industry since 1995 for the province as a whole (measured on the right axis), and the Northeast region (measured on the left axis). The share of real GDP attributable to the oil and gas industry in the Northeast region has risen from about

34% in 1995 to 44% in 2002[7]. For the province as a whole, this share has risen from 1.0% to 1.4% over the same period.

Increased gas production and consequently GDP, are driven by oil and gas industry investment, primarily construction investment. The discovery, drilling and production of each well requires inputs from many other sectors of the economy at a regional, provincial, national and international level. It is this investment that drives the overall economic activity in B.C.

Figure 3
Oil and Gas Industry Share of Gross Domestic Product, B.C. and the Northeast Region (%)

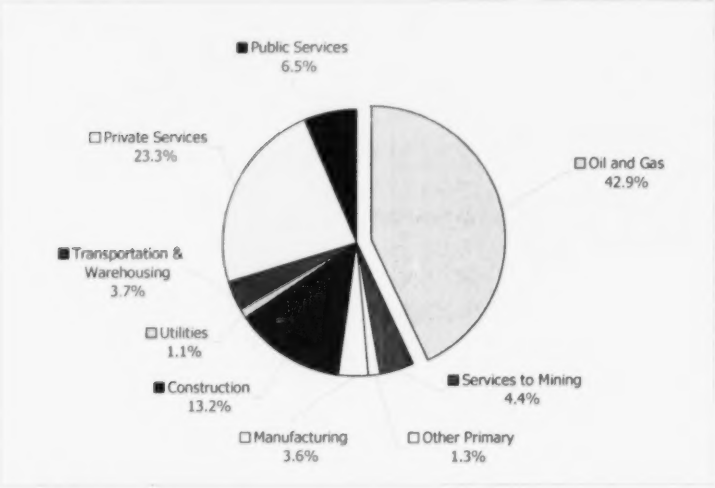


Source: Statistics Canada and the Centre for Spatial Economics

[7] Gross Domestic Product (GDP) estimates for the Northeast region are not available and they were calculated using a "provincial productivity" approach. Basically, productivity (sector GDP divided by employment in the sector) for each economic sector is calculated for the province and, using the regional employment information from the Labour Force Survey, it is possible to calculate a regional GDP for the Northeast. Adjustments have been made to the productivity approach to consider the fact that a proportion of workers in the oil and gas sector in British Columbia does not live in the province (they are not B.C. residents). Comparing productivity figures in the oil and gas extraction in British Columbia with Canadian averages and Alberta averages, productivity was adjusted to account for these workers that "produce" in British Columbia (thus contributing to British Columbia's GDP) but do not reside in British Columbia.

Figure 4 shows the relative direct contributions to regional GDP from all sectors; the overwhelming majority of GDP is attributable to the oil and gas industry.[8]

Figure 4. GDP by Economic Sector in Northeast B.C. - 2002

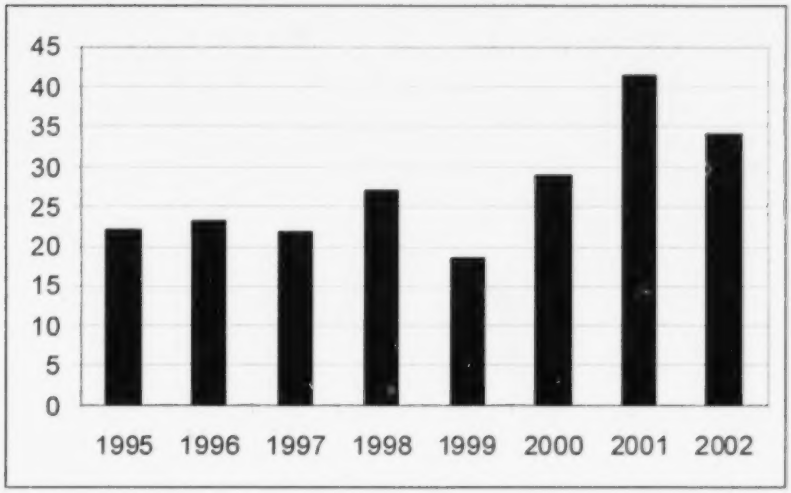


Source: C4SE estimates

The share of oil and gas investment as a portion of total investment in the province has risen from about 5% in the early 1990s to peak at 14% in 2001. The importance of the industry to non-residential construction investment is even more disproportionate (Figure 5). In 2001, the industry accounted for over 40% of non-residential construction investment. For a relatively small contribution to GDP, its contribution to investment is huge.

[8] Forestry is included in Other Primary.

Figure 5.
Oil and Gas Industry Share of Non-Residential Construction Investment, B.C. (%)

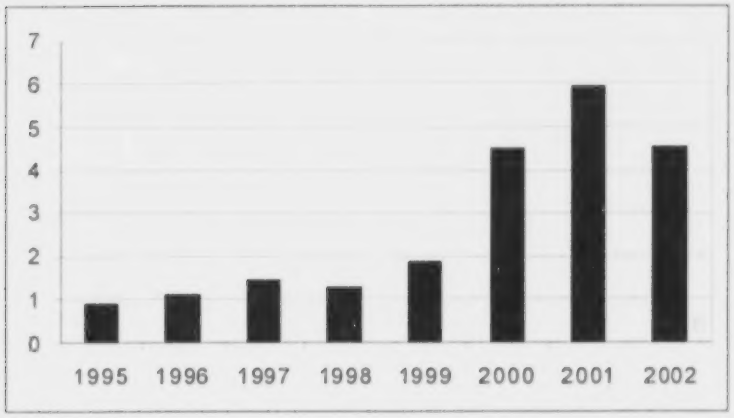


Source: Statistics Canada

Similar to the situation for investment, the oil and gas industry's contribution to provincial government revenues has grown significantly. Figure 6 shows that, as a percentage of total provincial revenues[9], oil and gas royalties have risen from below 1% in 1995 to peak at almost 6% in 2001. Natural gas royalties have risen from about $75 million in 1992 to peak at over $1 billion in 2001. This royalty revenue directly contributes to the provision of health, education and other public services in British Columbia.

[9] Measured on a Provincial Economic Accounts basis.

Figure 6.
Oil and Gas Industry Royalty Share of Provincial Revenues, B.C. (%)



Source: B.C. Energy and Mines

2.2 Macroeconomic Modelling Considerations

The importance of the oil and gas industry to the province depends not only on the size of its production and investment, but also on the types of goods, services and labour it utilizes. A specific effort has been made to ensure that the macroeconomic model uses data and assumptions that best represent the industry's activities.

2.2.1 Investment Expenditures

Machinery and equipment investment expenditures account for about 2% of overall oil and gas industry investment. The largest share of these expenditures is for the purchase of manufactured products, in particular, machinery. Such products are largely sourced from outside the province. The remaining 98% of oil and gas industry investment expenditures are for construction. The services to mining and construction industries are estimated to account for all of these expenditures, the largest part going to the construction industry.

2.2.2 Production Inputs and Value Added

The oil and gas industry depends on goods, services, labour and other inputs from a variety of other industries. Table 2 shows the contributions, or "inputs" of these other industries as a percentage of the oil and gas industry production, or "output" (which also includes the oil and gas industry's own value added). The shares are computed

using the 1999 input-output tables for British Columbia and those for Canada as a whole.[10]

Table 2.
Inputs Required to Oil and Gas Industry Output (%)

Industry	Input Share (%)
Oil and Gas Industry	0.1%
Services to Mining	7.8%
Other Primary	0.3%
Utilities	1.4%
Construction	1.9%
Manufacturing	10.9%
Petroleum and Coal	*1.5%2*
Chemicals	*1.7%*
Primary Metals	*1.2%*
Machinery	*3.5%*
Computer and Electrical	*1.5%*
Other	*1.8%*
Transportation and Warehousing	0.5%
Pipelines	*0.1%*
Other	*0.5%*
Private Services	11.5%
Trade	*1.0%*
Finance, Insurance and Real Estate	*5.3%*
Professional, Scientific and Management	*4.1%*
Other	*1.0%*
Public Services	0.8%
Value Added at Factor Cost	64.8%
Total Oil and Gas Industry Output	**100.0%**

Source: Statistics Canada and the Centre for Spatial Economics

As can be seen from the table, services to mining account for a significant share of oil and gas purchases. Almost 8.0% of total production output represents purchases from this industry. Manufactured products also account for a relatively large share of inputs with machinery products playing an important role in this regard. The largest sectors among private services are finance, insurance, real estate and professional services, and scientific and management services.

---

[10] Similar to the case for investment, the use of the Canadian tables is required because detailed data are not available for the province. Industry subcategories are shown in italics. Figures may not add due to rounding.

The largest share of inputs for the oil and gas industry is its own value added. Value added or GDP is defined by Statistics Canada as the value of the industry's output less the value of purchases of goods and services it makes from other industries to produce oil and gas. This difference is comprised of payments to labour and capital. Total GDP for the economy as a whole is computed by adding up GDP for each industry. Oil and gas GDP is a measure of its contribution to total GDP. Almost 65% of the industry's output represented value added in 1999. Labour purchases accounted for about 60% of the value added.

The shares in Table 2 can be used to estimate the impact on the various industries' sales and the oil and gas industry's GDP that could result from incremental industry output. For example, a $1 billion dollar increase in oil and gas industry output would increase purchases of manufacturing inputs by $109 million dollars ($1 billion x 0.109). Similarly, purchases of inputs from the services to mining industry would rise $78 million ($1 billion x 0.078). Continuing the same example, GDP in the oil and gas industry would increase almost $650 million ($1 billion x 0.648).

It should be noted that any increase in input purchases would include both domestic and foreign produced goods and services. The value of sales to domestic industries and purchases of local labour depends on the proportion of purchases sourced externally ("import shares"). Using a hypothetical example, if 60% of manufacturing industry products purchased by the oil and gas industry are imported and 40% sourced from within B.C., then sales to the provincial manufacturing industry would rise $43.6 million ($109 million as calculated above x 0.40), the remaining $65.4 million of products (60%) would be imports.

2.2.3 Labour Data in the Macroeconomic Impact Models

The macroeconomic impact models use employment data from the Labour Force Survey. The Labour Force Survey (LFS) is a household survey carried out monthly by Statistics Canada. The LFS divides working-age population into three mutually exclusive classifications: employed, unemployed and not in the labour force. Employment figures (people actually employed at the time of the survey) include detailed breakdowns by demographic characteristics, industry and occupation, job tenure and usual and actual hours worked. Labour force data reflect people living and working in British Columbia at the time when the survey is conducted. It should not be inferred that labour force data represent only permanent residents of a particular area.

In the case of this study, the LFS reports that 2,600 Northeast B.C. residents are working in the oil and gas extraction sector. Other industries that are related to the oil and gas sector include:

- Services to mining (oil and gas portion)
- Utilities (gas distribution)
- Manufacturing (petroleum refineries)
- Transportation & warehousing (oil and gas pipelines)

Based on supplementary analysis of Labour Force Survey data for these categories as well as oil and gas extraction, it is suggested that there are almost 11,400 "place of residence" employees that are working in oil and gas related Labour Force categories in British Columbia. That is, people living (either permanently or temporarily) in British Columbia and working in at least one of these oil-and-gas-related industry sectors. Of this total, 2,600 are identified as being directly employed in the oil and gas extraction sector, as noted above.

Table 3.
Direct Employment in Oil and Gas Related Labour Force Categories in British Columbia - 2003

Sector	People working in 2003
Oil & Gas Extraction	2,600
Support Activities for Mining and Oil and Gas Extraction	4,200
Pipeline Transportation	300
Petroleum and Coal Products Manufacturing	2,100
Natural Gas Distribution	2,200
Total Direct Employment in Oil and Gas related activities in British Columbia	**11,400**

Source: Centre for Spatial Economics based on Statistics Canada Labour Force Survey.

2.3 Identifying the Economic Contribution of the Oil and Gas Industry

The primary contribution of the oil and gas industry to the economy includes the amount of GDP, investment, and other macroeconomic variables attributable to the industry. This information does not provide an estimate of the total contribution of the industry, since it does not take into account the indirect contribution of the industry's activities on the rest of the economy and the province's fiscal position.

In reality, the activities of the oil and gas industry represent a sequential process. The first part of the process involves expenditures on exploration. Expenditures to develop gas wells represent the second part of the process. The final part of the process involves expenditures needed to extract the gas.

The analysis of these activities is a dynamic one. It shows the time pattern of expenditures and their impacts. It is this type of analysis for which the macroeconomic impact models employed are well suited.

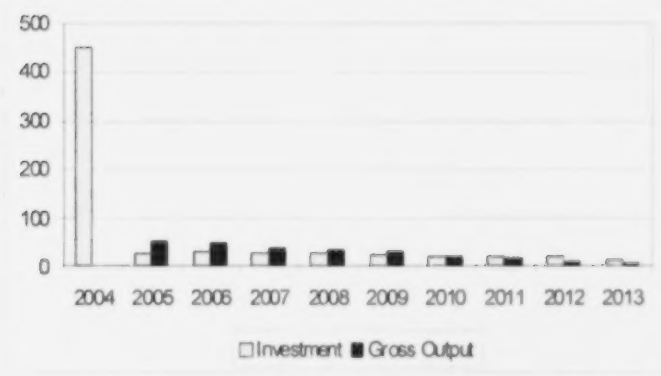
The question of interest for the impact analysis conducted here is: "What is the impact on the economy of an additional $1 in investment expenditures associated with the development and operation of the wells?"

To determine the investment expenditures needed for the analysis, the B.C. Oil and Gas Model developed by CERI is employed. Changes are made to the key determinants of gas activity in the model that lead to increased development and production expenditures over the period of analysis. These changes are then fed into the macroeconomic impact models to examine the economic impacts.

The amount of well development expenditures was targeted to be $500 million or about $450 million 1997 dollars – about 0.5% of B.C.'s real GDP in 2004 and about 13% of GDP in the Northeast region.

The development expenditures take place in 2004, which leads to gas production starting in 2005 and continuing to 2013 when the associated wells are depleted. Some maintenance investment is assumed to occur over this period. The time pattern of the investment expenditures and resulting oil and gas industry gross output measured in millions of 1997 dollars are shown in Figure 7. The cumulative increase in GDP to 2013 associated with the gross output is about $165 million 1997 dollars.

Figure 7
Oil and Gas Investment and Gross Output
($1997 Millions)



Source: C4SE.

Before presenting the results of this analysis, the study provides a qualitative discussion of the expected contribution of the industry to the economy. The results of the quantitative analysis are then easier to understand.

2.3.1 Economic and Fiscal Contribution

The contribution of the oil and gas industry to the economy as a whole originates through its purchases of capital goods and goods and services needed as inputs to the oil and gas production process. The nature of these purchases was outlined earlier in Section 2.2.

An increase in oil and gas industry expenditures raises the demand for goods and services in the economy. To produce these additional goods and services, the firms involved must, in turn, purchase additional goods and services from suppliers to meet this higher demand.

The additional services include the purchase of labour services. The employment resulting from this increased demand for labour services leads to increases in labour income and additional expenditures by households. The higher household expenditures require firms to purchase additional goods and services to meet the higher demand. They, in turn, hire more workers, which purchase additional goods and services, and so on.

Part of the additional purchases by firms will be for capital goods needed to increase the firms' productive capacity to provide the additional goods and services required by the oil and gas industry and firms supplying the industry and their suppliers in turn. The increases in investment will further increase the demand for goods and services.

The increase in employment in the economy will increase net in-migration to the province or Northeast region. The resulting increase in population will increase the demand for goods and services, including government services. In fact, the increase in population will result in increased government expenditures and the hiring of additional government employees. However, additional incomes, both corporate and personal, generated by the increased economic activity will lead to higher government revenues. Normally, a net increase in government balances is the end result of the increased activity (i.e. the revenue gains associated with the increased economic activity exceed increased government expenditures required by the additional population).

All of the above activity serves to increase overall GDP, employment, population, and government balances. The extent of this increase depends on the economic import coefficients associated with the expenditures. The higher the proportion of expenditures that is sourced in the local economy, the greater will be the economic contribution to the local economy.

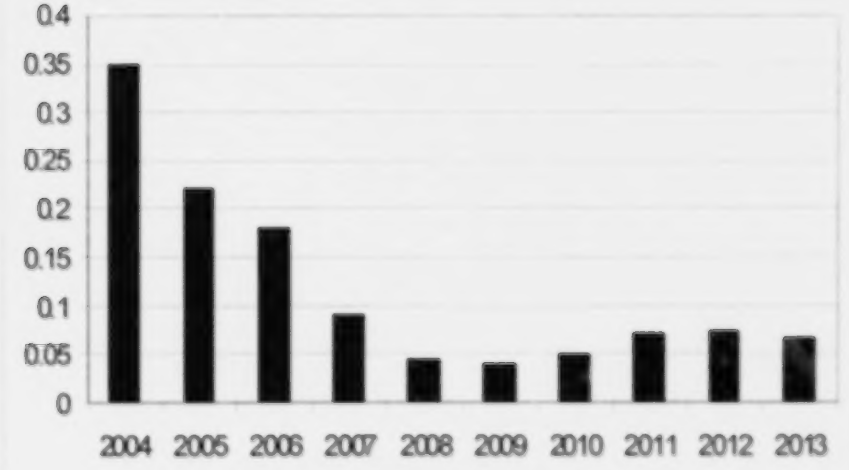
2.3.2 Quantifying the Economic Contribution of the Industry

- **British Columbia**

The results for the development scenario for B.C. are shown in Table 4 to Table 6. The first table shows the impacts for key and demographic economic indicators and the main categories of expenditures. Table 5 shows the impact on real GDP for the industry categories included in the model. The GDP impacts are measured as the percentage difference from the base case projection. The impacts on the province's fiscal position are shown in Table 6. Both the percentage and level differences are shown for these variables. The levels are measured in millions of current dollars.

The time profile of the impact of the increased oil and gas industry activity is shown in Figure 8. This figure shows the percentage increase in provincial real GDP from its base case values. As can be seen from the figure the impact peaks with the initial development expenditures and then declines as additional production slowly falls over the period.

Figure 8
Expenditure Impact on B.C. Real GDP
(Percentage Difference from Base Case)



Source: C4SE.

The reason for the weaker impact near the middle of the projection period is associated with the expenditure profile. The sharp increase in expenditures in the first

year is multiplied up above the value of these expenditures. When expenditures are reduced from their high first year level over the remainder of the period, the multiplier goes into reverse causing the impact to overshoot in a downward direction. Near the end of the period the impact stabilizes at a lower level.

Table 4
Key Indicator Impact Table, B.C.
(Percentage or Level Difference from Base Case)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Real GDP % Difference	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.1	0.1	0.1
Consumer Expenditures	0.2	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Gov't Current Expenditures	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Gov't Capital Expenditures	0.4	0.5	0.8	0.2	0.0	-0.2	-0.2	-0.1	0.0	0.0
Residential Expenditures	1.0	0.8	0.6	0.2	-0.2	-0.2	-0.1	0.0	0.0	0.0
M&E Investment Expenditures	1.1	0.8	0.5	-0.3	-0.2	-0.2	0.0	0.1	0.1	0.1
Non-Residential Construction Expenditures	8.2	1.1	0.9	-0.3	0.1	0.1	0.1	0.3	0.3	0.2
Exports	-0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Imports	0.5	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Real Per Capita GDP % Difference	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CPI % Difference	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hourly Wage Rate % Difference	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Population										
% Difference	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
Difference 000s	0.0	4.1	4.9	4.8	3.3	2.6	1.8	1.3	1.1	1.0
Unemployment Rate Difference	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Corporate Profits After Tax % Difference	0.2	0.4	0.3	0.3	0.6	0.3	0.1	0.0	-0.1	-0.2
Real Personal Disposable Income % Differe	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Federal Net Lending $ Millions Difference	114.9	68.4	38.7	-7.3	-17.7	-18.1	-8.9	2.9	7.0	4.7
Provincial Net Lending $ Millions Difference	94.8	91.2	65.1	33.7	21.6	22.9	26.9	36.1	40.3	40.7
Local Net Lending $ Millions Difference	-1.8	3.1	-4.0	-0.3	1.2	11.3	12.9	12.8	10.3	9.8

Table 5
Industry Impact Table, B.C.
(Percentage or Level Difference from Base Case)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Real GDP @ Basic Prices: % Difference From Base Case										
Total	**0.3**	**0.2**	**0.2**	**0.1**	**0.0**	**0.0**	**0.0**	**0.1**	**0.1**	**0.1**
Oil & Gas	0.0	2.0	1.7	1.5	1.3	1.0	0.8	0.6	0.4	0.2
Services to Mining	12.6	1.1	1.2	1.0	1.0	0.8	0.7	0.6	0.5	0.3
Other Primary	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Utilities	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.1	0.1	0.1
Construction	2.6	0.7	0.7	0.0	0.0	-0.1	-0.1	0.0	0.1	0.1
Manufacturing	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Transportation & Warehousing	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Private Services	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1
Public Services	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0

Table 6
Fiscal Impact Table, B.C.
(Percentage or Level Difference from Base Case)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Revenues										
% Difference	0.4	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Difference	105.4	102.7	94.6	51.3	30.8	19.4	19.7	25.6	26.2	21.2
Direct Taxes Persons										
% Difference	0.3	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.0
Difference	17.6	14.0	13.0	5.8	0.8	0.4	1.3	3.4	4.3	3.7
Direct Taxes Business										
% Difference	0.2	0.3	0.2	0.2	0.4	0.2	0.1	0.0	-0.1	-0.2
Difference	1.6	2.6	1.8	1.5	2.2	1.3	0.7	-0.3	-1.1	-1.3
Social Insurance										
% Difference	0.6	0.4	0.3	0.1	0.0	0.0	0.0	0.1	0.1	0.1
Difference	6.0	4.3	3.6	1.1	-0.5	-0.4	0.1	0.8	1.1	0.9
Indirect Taxes										
% Difference	0.6	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.1	0.0
Difference	63.5	42.2	36.6	10.5	1.0	-3.4	-0.6	5.3	8.7	7.5
Other Taxes Persons										
% Difference	0.3	0.3	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.0
Difference	6.0	4.8	4.4	1.9	0.2	0.1	0.4	1.1	1.4	1.2
Investment Income										
% Difference	0.2	0.7	0.6	0.4	0.4	0.3	0.2	0.2	0.1	0.1
Difference	10.7	33.8	30.6	24.9	21.8	17.8	15.1	13.3	10.3	7.9
Royalties										
% Difference	0.1	1.0	0.8	0.7	0.6	0.5	0.4	0.3	0.2	0.2
Difference	2.0	26.5	24.0	21.5	20.0	16.7	13.9	11.6	8.4	6.3
Expenditures										
% Difference	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	-0.1
Difference	1.7	1.2	19.9	20.6	15.5	2.8	-3.6	-10.8	-16.1	-20.8
Goods and Services										
% Difference	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Difference	0.0	0.0	15.8	19.6	19.9	14.0	11.3	8.0	6.2	5.4
Transfers to Persons										
% Difference	0.0	0.1	0.2	0.2	0.1	0.1	0.0	0.0	0.0	0.0
Difference	1.7	5.6	8.8	8.5	6.3	3.7	3.1	2.6	2.6	2.4
Direct Relief Payments										
% Difference	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Difference	0.0	0.5	2.4	2.8	2.6	1.9	1.5	1.0	0.8	0.7
Workers' Compensation										
% Difference	0.2	0.5	0.4	0.2	0.0	-0.1	0.0	0.0	0.1	0.1
Difference	1.7	4.4	3.3	2.1	0.3	-0.6	-0.3	0.3	0.8	0.8
Other Transfers to Persons										
% Difference	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Difference	0.0	0.7	3.1	3.6	3.4	2.4	1.9	1.3	1.0	0.9
Transfers to Business										
% Difference	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
Difference	0.0	0.2	1.1	1.3	1.2	0.9	0.7	0.5	0.4	0.3
Interest on Debt										
% Difference	0.0	-0.2	-0.5	-0.6	-0.7	-0.8	-0.9	-1.1	-1.3	-1.5
Difference	0.0	-6.0	-11.5	-15.7	-18.4	-20.2	-22.2	-24.4	-27.2	-30.6
Fixed Capital	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
% Difference	0.7	0.8	0.7	-0.1	-0.3	-0.3	-0.1	0.1	0.1	0.1
Difference	9.8	11.8	11.3	-1.5	-5.1	-5.4	-2.8	1.1	2.7	2.2
Net Lending										
Difference	94.8	91.2	65.1	33.7	21.6	22.9	26.9	36.1	40.3	40.7

The profile of impacts for real GDP is also observed for many of the indicators shown the impact tables. The changes in population, for example, follow the impacts on GDP. The initial increase in development expenditures causes an increase in employment, which leads to an increase in population. Once the impact weakens with the relatively lower production expenditures – relative to investment – the increase in population diminishes. The values for many of the indicators in the tables actually fall below their base case values near the middle of the projection period.

An example of this performance is government expenditures. While governments increase their investment and current spending in line with early increases in population, the reduction in activity from the higher values at the beginning of the period result in a reduction of such spending as the population and output growth impacts fall. Nevertheless, spending recovers towards the end of the period.

The industries that show the largest impacts are oil and gas extraction, services to oil and gas, and construction. The increases in employment are largest for the private services industry.

The fiscal impacts generally follow the pattern shown for GDP described above. While the cumulative value of the reduction in budget balances as measured by net lending over the period is positive for the federal government, the actual value of net lending falls below base case values in the middle of the period.

- **Northeast Region**

The results for this scenario are shown in Table 7 and Table 8. The impact of the size of the expenditure increases has a sharp impact on the Northeast region's economy. As mentioned above, the investment expenditures are about 10% of local GDP. The impact on real GDP peaks in 2004 at 6.9% above its base case value. These impacts diminish over the projection period in line with smaller increases in oil and gas expenditures. The impact of the multiplier operating in reverse as discussed above for the province as a whole is more obvious for the Northeast region.

The increase in development expenditures leads to a large reduction in net exports as imports rise. By the end of the period they turn positive as the increase in exports from higher production and exports dominate increases in imports.

A large increase in residential investment caused by higher incomes and population in the first four years of the period reverses thereafter as the increase in population diminishes.

The initial shock to the economy leads to a housing "boom" and building in excess of longer term housing needs. This performance is also seen for other investment, as firms react to the relatively large impacts in the first three years of the period. It

occurs because of the assumption of adaptive expectations employed in the model – people look at what has happened in the recent past to make decisions. If firms and households were forward looking and knew that production and employment would fall with the depletion of the wells, they would probably reduce their capital expenditures and possibly not move to the region. Such a response could lead to labour shortages and larger increases in imports, which would substantially reduce the economic impact of the expenditures.

Similar to the results for the province, the oil and gas extraction, oil and gas services, and construction industries see the largest impact on GDP. The increase in employment is the largest for private services.

- **Summary Measures of Oil and Gas Impacts: GDP Multipliers**

Summary measures of the impacts associated with the development scenario for key economic indicators in the province and the Northeast region are shown in Table 9. These measures provide an answer to the question raised at the beginning of this section regarding the impact of an additional $1 million of oil and gas investment on the economy.

The measures refer to the total impact on the indicator over the development and extraction period. They are computed as the ratio of the sum of the additional amount of the indicator over the period in each year, divided by the total amount of additional oil and gas investment expenditures over the period. For example, the sum of the increase in real GDP each year above its base case value over the period for the scenario in the province was $1,568 million 1997 dollars. The additional oil and gas investment expenditure over the period was $626 million 1997 dollars - the latter number includes maintenance expenditures as well as development expenditures. The ratio of these two numbers is 2.50. This ratio suggests that for every $1 of investment in a gas well and its maintenance, $2.50 of GDP is created over the period of time covering the development and life of the well (GDP multiplier).

The impact of additional oil and gas investment on GDP is greater for the province than the Northeast region. The increase in GDP in the Northeast is $1.30 in contrast to $2.50 in the province as a whole, as the region is more dependent on "imports" from the rest of the province. The extent of this can be partly seen from the larger reduction in net exports – exports minus imports – for the region shown in Table 7.

Table 7
Key Indicator Impact Table, Northeast Region
(Percentage or Level Difference from Base Case)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Real GDP % Difference	6.9	3.1	2.2	0.6	0.7	0.6	0.5	0.6	0.4	0.3
Consumer Expenditures	6.3	3.9	3.2	1.1	1.0	0.9	0.9	0.9	0.6	0.5
Residential Expenditures	21.9	32.2	8.9	-5.0	-13.7	-22.1	-99.1	0.0	0.0	0.0
Business M&E Investment Expenditures	23.4	9.1	6.9	-16.7	-6.8	-4.6	0.9	1.2	0.6	0.0
Business Non-Residential Construction Expenditures	19.4	1.7	1.6	-0.5	0.6	0.6	0.7	0.7	0.5	0.4
Government Goods & Services	1.2	2.8	3.1	2.8	2.3	1.8	1.3	0.9	0.7	0.5
Government Capital Expenditures	12.1	11.8	14.4	-2.0	-4.1	-6.5	-5.2	-6.2	-6.8	-5.5
Net Exports Difference $97 Millions	-422.9	-119.3	-71.1	57.5	27.0	18.9	4.0	-14.1	-11.6	-7.5
Real Per Capita GDP % Difference	5.6	0.3	-0.8	-2.1	-1.5	-1.2	-0.8	-0.3	-0.2	-0.2
Unemployment Rate Difference	-2.8	-0.2	0.0	0.8	0.3	0.6	0.4	0.3	0.2	0.1
Population										
% Difference	1.2	2.8	3.1	2.8	2.3	1.8	1.3	0.9	0.7	0.5
Difference	0.9	2.0	2.3	2.1	1.8	1.4	1.0	0.7	0.5	0.4
Annual Wage Rate % Difference	0.8	1.0	0.7	0.4	0.4	0.6	0.5	0.4	0.2	0.1
Consumer Price Deflator % Difference	0.6	0.6	0.6	0.5	0.4	0.3	0.2	0.1	0.1	0.1
Real Disposable Income % Difference	7.5	5.1	4.5	2.0	1.8	1.5	1.2	1.2	0.9	0.6

Table 8
Industry Impact Table, Northeast Region
(Percentage or Level Difference from Base Case)

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Real GDP @ Basic Prices: % Difference From Base Case										
Total	**6.9**	**3.1**	**2.2**	**0.6**	**0.7**	**0.6**	**0.5**	**0.6**	**0.4**	**0.3**
Oil & Gas	0.0	2.0	1.7	1.5	1.3	1.0	0.8	0.6	0.4	0.2
Services to Mining	13.9	1.3	1.3	1.1	1.1	0.9	0.7	0.7	0.5	0.4
Other Primary	11.4	4.7	3.3	0.1	0.5	0.4	0.5	0.8	0.6	0.4
Utilities	4.7	3.0	2.5	1.0	0.9	0.8	0.7	0.7	0.5	0.3
Construction	18.9	4.7	2.6	-1.1	-0.4	-0.4	-0.2	0.6	0.4	0.3
Manufacturing	5.0	1.8	1.3	-0.1	0.1	0.1	0.2	0.3	0.2	0.2
Transportation & Warehousing	6.3	2.7	2.0	0.0	0.3	0.3	0.4	0.5	0.4	0.2
Private Services	8.5	4.2	2.9	0.2	0.4	0.4	0.4	0.8	0.5	0.4
Public Services	3.2	3.1	3.0	2.1	1.8	1.5	1.1	0.9	0.6	0.5

Table 9
Summary Impact Measures: Development Scenario Multipliers

Variable	British Columbia	Northeast British Columbia
GDP	**2.50**	**1.29**
Consumer Expenditures	1.36	0.79
Residential Investment Expenditures	0.33	0.16
Non-Residential Investment Expenditures	1.40	1.08
Net Exports	-0.65	-0.88
Budget Balances ($ Current)		
Federal	0.30	NA
Provincial	0.76	NA
Local	0.09	NA

The increased investment expenditures have a significant impact on consumer expenditures. For the province as a whole, each $1 of investment results in $1.36. In the case of the Northeast region the increase is $0.79. Residential expenditures also increase, but to a smaller extent at $0.33 and $0.16 for the province and Northeast region, respectively.

Non-residential investment increases in excess of oil and gas investment in the province as a whole with oil and gas investment leading to an additional $0.40 of non-oil and gas investment for every $1 of oil and gas investment. Again, the increase is smaller for the Northeast region.

For government budget balances, the measure is computed as the sum of the increase in the budget surplus each year over the period divided by the investment expenditures measured in current rather than 1997 dollars. As is seen from the table, the provincial government registers the biggest improvement in its cumulative budget surplus – or reduction in government debt, assuming the surplus is applied to debt reduction – with every additional $1 dollar of investment leading to a $0.76 increase in the cumulative surplus or reduction in provincial debt.

To get some idea of the magnitude of current oil and gas investment on the economy, the ratios in Table 9 multipliers are applied to the level of oil and gas industry investment in 2002, which is shown in Table 1. Under the assumption that this investment of about 1.6 billion 1997 dollars is used for well development and extraction, the values for GDP and the other indicators associated with investment are shown in Table 10.

Table 10
Future Oil and Gas Industry Impacts
2002 Oil and Gas Investment

Variable	British Columbia	Northeast British Columbia
GDP	**3,933**	**2,030**
Consumer Expenditures	2,144	1,243
Residential Investment Expenditures	525	256
Non-Residential Investment Expenditures	2,193	1,691
Net Exports	-1,016	-1,378
Budget Balances ($ Current)		
Federal	556	NA
Provincial	1,428	NA
Local	167	NA

As can be seen from the table, the investment made by the industry in 2002 will result in an additional $3.9 billion of GDP for the province as a whole and $2.0 billion in the Northeast region over the period 2002-2011. For the province as a whole, this increase is 3.0% of current GDP, while for the Northeast region it is about 47.0% of current GDP.

The 2002 investment will reduce provincial government debt $1.4 billion by the end of 2011. The federal government will see a reduction of $556 million in its debt and local government debt will fall $167 million, assuming the surplus is applied to debt reduction.

It is clear from these results that the oil and gas industry has had and will continue to have an important impact on the economy of British Columbia. This impact is particularly important for the Northeast region of the province where the bulk of oil and gas activity is taking place.

3. SURVEY OF THE OIL AND GAS INDUSTRY EXPENDITURES

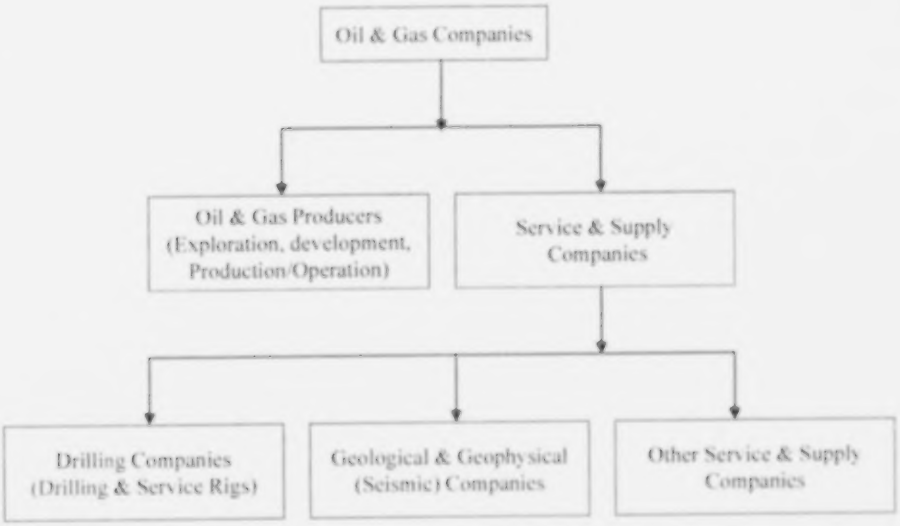
3.1 Data Requirement

The study requires two types of data: (i) primary data and (ii) secondary data. Primary data are those which are not available through published sources and must be collected through surveys. Most data required for the expenditure analysis falls in this category. Data that are already available though published sources are referred to as the secondary data.

3.1.1 Primary Data Collected for the Study

The primary data collected for this study were the labour and capital expenditures by type of activity and jurisdictional source. Since activities of oil and gas companies vary, they were segregated into separate categories such as the oil and gas producers and service and supply companies. The latter are further divided into three sub-categories based on the type of services they provide, including drilling companies, geological and geophysical (seismic) companies, and other service and supply companies (Figure 7).

Figure 7. Grouping of Oil and Gas Companies for the Purpose of Data Collection

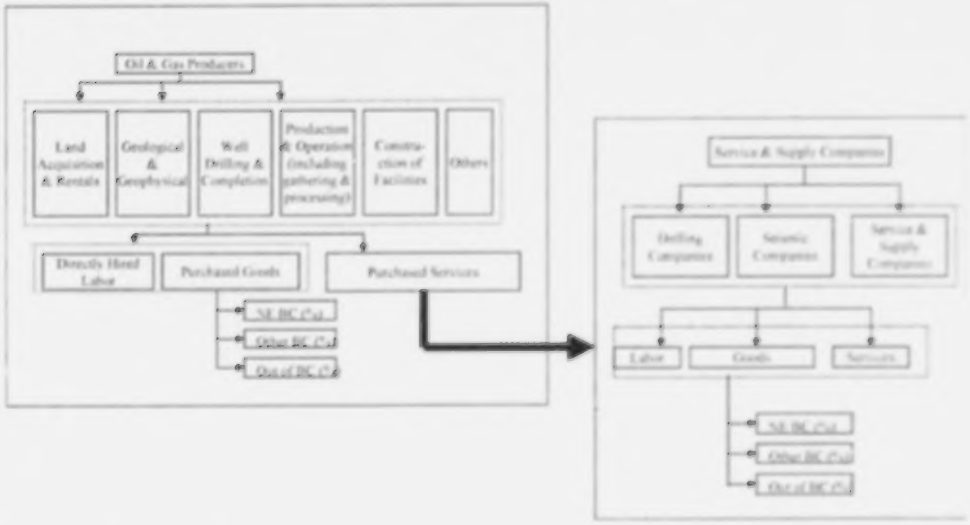

Oil & Gas Companies
Oil & Gas Producers (Exploration, development, Production/Operation)
Service & Supply Companies
Drilling Companies (Drilling & Service Rigs)
Geological & Geophysical (Seismic) Companies
Other Service & Supply Companies

The data collection process is outlined in Figure 8. The intent of the data collection process was to:

- capture all expenditures originating with directly producers, and
- capture all expenditures made by the service and supply companies (which are essentially the indirect expenditures of the producer companies).

The information collected differs across these groups. For example, information was collected at the activity level for oil and gas producers (e.g., land acquisition and rental, geological and geophysical, drilling and others). In the case of service and supply companies, information was collected by type of major activities (e.g., drilling, seismic and all other services and supplies provided).

Figure 8. Overall Survey Methodology



3.1.2 Interpretation of Expenditure Survey Results

As with any quantitative study, caution needs to be exercised in the interpretation of estimates obtained from this study.

1. All labour considered to be sourced from within B.C. is defined for purposes of this study to be:
   - employees directly employed annually or seasonally in production, operation, and facility construction activities undertaken by the oil and gas producers in B.C.; and

- employees hired annually or seasonally by drilling, seismic and other service and supply companies to conduct work in B.C.

In essence, labour includes all employees of companies surveyed who are working in B.C. These can be B.C. residents, staff in B.C. branch offices of oil and gas producers and/or service and supply companies, and workers living in drilling crew camps and other accommodation while working in B.C.

2. Similarly, in the case of goods and services sourced from Northeast B.C. (by either producers or service and supply companies), local purchases are defined as those bought through local vendors, although the actual goods themselves might have been manufactured outside the region.

3. The population of "other" service and supply companies is unknown. Hence it is difficult to verify whether the sample size for the survey is large enough to represent the actual population.

4. Since both the regional and provincial economies of B.C. are part of an open economy with significant inter-regional, inter-provincial and international trade, there is a need to recognize that some expenditure will necessarily be made outside of the local and provincial economies.

3.2 Analysis of Expenditure Survey Data

This section analyzes expenditure patterns of oil and gas industry on labour, goods and services, particularly focusing on the jurisdictional sources (i.e., Northeast B.C., other parts of B.C. and outside B.C.).

Since the expenditure patterns may vary across producers and service and supply companies, separate analyses were carried out for each of these groups. Producers were divided into three classes: (i) large, (ii) mid-sized; and (iii) small. Large producers include those companies whose individual gas production during the first quarter of 2003 was 2% or more of the total gas production from Northeast B.C. The mid-size producers are companies with a production share between 0.5% and 2% during the same period. Small producers for purposes of this study are those remaining companies with production share of 0.5% or less each during the same period.

For each class of producers, analyses were carried out by major activity levels: drilling, production and operations, construction, and other (e.g., land acquisition and rentals, geological and geophysical). Data for producers were aggregated using weighted averages; weights were assigned based on the relative size of expenditures for each respondent. There were 96 producers operating in Northeast B.C. in the first quarter

of 2003. Of these, 15 producers account for more than 76% of the total production. Sixty-six small companies together account for only 5% of the total production. The rest is attributable to medium-sized companies.

Similarly, service and supply companies were segregated into three groups based on their activities: (i) drilling companies; (ii) seismic companies and (iii) other service and supply companies. Their expenditure patterns were analyzed separately.

3.2.1 Analysis of Aggregate Industry Expenditure Patterns

A major outcome of the survey is the identification of aggregate oil and gas industry (producers and service and supply companies) spending on goods, services and labour across jurisdictions. Aggregating the results of the producer and service sector expenditures is challenging, owing to differences in types of activities and differences in the relative labour and capital intensities of these activities. For example, producers' major activities include drilling, facility construction and production and operations, which have a relatively low labour intensity (requiring less labour and more capital). The service and supply companies, on the other hand, engage in activities requiring larger labour outlays on activities such as well completion, testing and construction.

Another key challenge is the unknown population size of the service and supply companies, without which it is difficult to ascertain clearly the size of the sample vis-à-vis the population, which affects the confidence levels of extrapolating sample results to the entire population of service and supply companies.

In terms of jurisdictional sourcing of expenditures, 30% of the total expenditures made by producers on directly hired labour are expended within the province. Service and supply companies, on the other hand, report that 63% of their total labour expenditures stays within the province.

While the analysis of results by the economic categories surveyed such as the oil and gas producers versus the service and supply companies is meaningful, it is also interesting to examine the results over the entire oil and gas industry (oil and gas producers plus service and supply companies). An aggregation of results is therefore created. The expenditure proportions by activity and jurisdictional source is applied to the purchased services of the oil and gas producers. Thus the expenditure ratios from the service and supply companies are applied to the 61% of oil and gas producer expenditures, which are made on purchases from the service and supply companies.

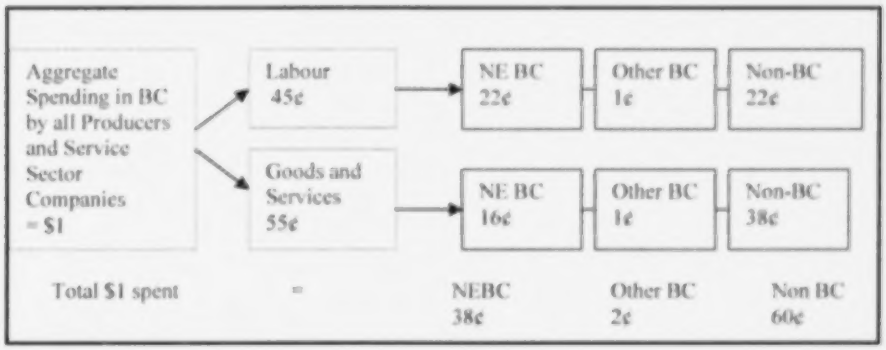
The share of aggregate labour expenditures is calculated by adding half of 61% (i.e., the share of labour in total service and supply company expenditures) to the share of directly hired labour expenditures for the oil and gas producers. Thus, in total labour accounts for 45% of total oil and gas sector expenditures. Applying similar

methodology to the goods and service expenditures yields a share of 55% of the total oil and gas sector expenditures.

The aggregated jurisdictional shares for labour are weighted averages of jurisdictional shares of directly hired labour and jurisdictional labour shares of service and supply companies. The weighting factors are 14.6% for directly hired labour and 32% (i.e., 50% of 61%) for labour components of service and supply companies. The aggregated jurisdictional shares for goods & services were calculated in the same way.

The findings are expressed in Figure 9 in terms of tracking $1 through a full range of expenditure decisions. If $1 is spent in the oil and gas sector in B.C., 45¢ is on labour and 55¢ is on goods and services. Of the 45¢ labour expenditures, 23¢ was spent on labour sourced from within B.C. and the remaining 22¢ was spent outside of the province. Of the 55¢ spent on goods and services, 17¢ was spent on goods and services sourced from within the province, with the remaining 38¢ being spent outside the province.

Figure 9. Flow of Oil and Gas Sector Expenditures in B.C., 2002



A large segment (about 60%) of expenditures budgeted for exploring and developing Northeast B.C. properties will be directed to labour, equipment and services purchases outside of B.C. primarily for the following structural reasons:

- The oil and gas industry depends on a large number of specialized service providers, equipment manufacturers and suppliers. The growth pattern of these businesses has developed over many decades of operation.

- Service providers and equipment manufacturers locate closer to their primary market, which is Alberta. The concentration of producers and service providers in Alberta (principally in Calgary) facilitates the day-to-day flow of business efficiently and effectively through physical proximity

to a highly integrated network of businesses operating across the North American oil and gas industry.

- Service providers and equipment manufacturers located in Alberta experience a natural competitive advantage which cannot be overcome by regional centers (for example, Fort St. John, Halifax, or Regina)

- Production and operations activities, typical of more mature areas of development, tend to have the highest proportion of "local" expenditure components for labour, goods and services. Since B.C.'s oil and gas industry is relatively early in its exploration, development, and production cycle, most expenditures, particularly for specialized equipment, tend to be made outside the area of activity.

- As production and operation activities grow in B.C., creating more production infrastructure, expenditures for labour and goods and services will likely increase in Northeast B.C. and present new opportunities for local service providers and employees.

- The infrastructure surrounding the oil and gas industry in Alberta includes university and technical facilities which provide training for oil and gas industry personnel, tax and regulatory services which facilitate their operation, capital markets geared to financing oil and gas investment, and specialized manufacturing and services. These have grown up for decades around the oil and gas industry in Alberta and make it very difficult for competing centres to overcome the competitive advantages gained by businesses locating and operating in Alberta.

- As in other sectors, Canada's oil and gas industry (producers, drillers, etc.) are consolidating into larger and larger companies that create competitive advantage through efficiencies realized by scale. In this context, more and more North American head offices are locating in Houston rather than Calgary. These consolidations are seen to be necessary to compete on a global scale.

As a consequence of these factors, Calgary is unquestionably the head office location for the oil and gas industry in Canada. Analogous situations occur with other major manufacturing, finance and resource sectors in Canada. For example, Toronto is unquestionably Canada's finance center. Windsor and Southern Ontario are the center of Canada's automotive industry. And for all of the above reasons, Vancouver is and will likely remain the head office location for Canada's forest and mining industries.

3.2.2 Estimating the Value of Expenditures

Using the information in Figure 9, it is possible to estimate oil and gas sector spending in B.C. in 2002. The Canadian Association of Petroleum Producers (CAPP) reports that approximately $3.4 billion[11] was spent by the B.C. oil and gas industry in 2002. Results of this study would suggest that 40% of this $3.4 billion (i.e., about $1.4 billion) was spent on labour, goods and services sourced within the province, while the remaining $2 billion, was spent on labour, goods and services sourced outside the province.

It is not possible to state categorically how much of this expenditure stays within the province. For example, if pipe or heavy equipment is bought through a local vendor, it is considered to be a locally spent expenditure. But if such goods are actually manufactured in another province or the U.S., then much of the economic benefit will actually leave the province to the original manufacturer. This is not a situation unique to B.C., it is simply a fact of operating in an open economy

3.2.3 Analysis of the Producer Expenditures

The expenditure patterns of the producers and the service sector companies are quite different. This is largely a result of the type of activities engaged in by the two groups and the differences in the relative labour and capital intensities of the various activities. For example, the major activities engaged in directly by the producers include drilling, facility construction and production and operations. These activities have a relatively lower labour intensity (less labour and more capital). The service and supply companies on the other hand engage in activities requiring larger labour outlays on activities such as well completion, testing and construction.

A significant component (24%) of producer expenditures are budgeted for directly purchased equipment such as compressors, pump jacks, steel pipe for pipelines, dehydrators and other similar equipment that needs to be installed to produce as well as transport oil and gas in B.C., Alberta and across Canada. Much of this equipment is manufactured in Ontario, Europe, Asia and elsewhere. Consequently, the benefits of some oil and gas investment decisions made in Canada are global in nature.

About 15% of producer expenditures are also budgeted for directly hired labour, including salaries and administrative costs for geologists, engineers, accountants, operations personnel, etc. who work in both companies' head offices and in field locations where their oil and gas facilities are located. For exploration and drilling activities, most direct hired labour are technical specialists involved with planning, executing and analyzing data associated with geophysical and drilling activities. These personnel will normally be located in head offices in Alberta. For production operations,

---

[11] Exclusive of royalties, taxes and land sales revenues.

staff attached to engineering and planning functions will be typically centralized in head office locations with supervisory and direct operational personnel located in field locations where operating facilities (wells, pipelines, and treating equipment) are located. Labour is typically the smallest of the budgeted categories for direct oil and gas expenditures.

The majority of producer spending (61%) is for work undertaken by third-party service and supply companies, including seismic, drilling, pipeline and construction companies that provide services in B.C. and the rest of Canada. The goods and services sourced directly for production operations by producers will normally be stockpiled and procured from centralized distribution locations and distributed on a "just in time" basis to field locations throughout Canada. Oil and gas equipment tends to be manufactured, assembled, warehoused, and/or shipped from distribution centres located in Alberta. In fact, Alberta's manufacturing and distribution markets for oil and gas production equipment (pump jacks, well heads, drilling and serving rigs, etc.) provides equipment and supplies globally as well as throughout Canada.

As can be seen from Table 10, oil and gas producers spent more than 60% of their total expenditures through third-party service and supply companies. About 15% of the total expenditure was spent on directly hired labour, and 24% was spent on direct purchase of goods and services. Directly hired labour includes all the head office personnel engaged in variety of activities undertaken by the oil and gas industry, as well as the company personnel engaged in field operations. The directly purchased goods include such items as compressor stations, pump jacks, dehydrators and other similar equipment that needs to be installed to produce as well as transport oil and gas.

Table 10. Analysis of Total Expenditures for Oil and Gas Producers, 2002

Producers: Average Expenditure Share (%)	
Directly Hired Labour	15%
Directly Purchased Goods and Services	24%
Goods and Services Purchased through Service and Supply Companies	61%
Total	100%

Drilling, production and operation, and facility construction account for almost equal shares in total expenditures on directly hired labour in 2002 (Table 11). Drilling and construction of facilities also represent the main expenditures for directly sourced goods and services. Such purchases include surface casing, production casing, tongs, line hangers, drilling bits, drilling mud, reamers, stabilizers and chemicals among other things.

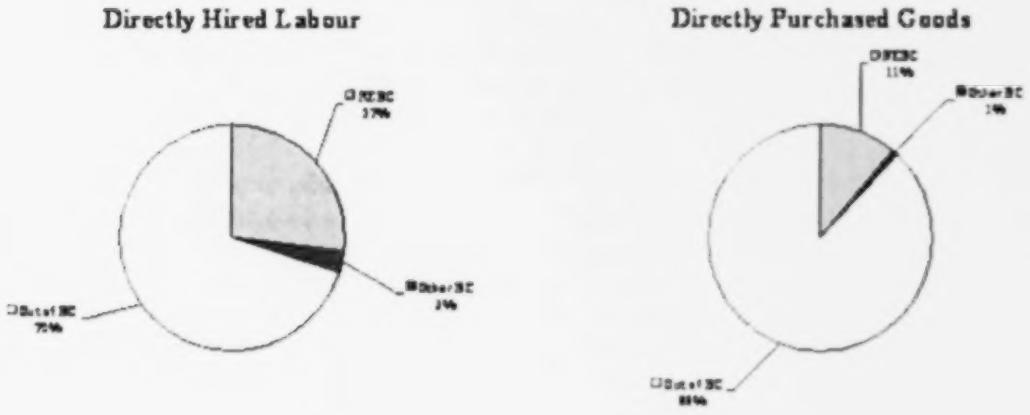
Table 11. Activity Shares of Directly Hired Labour and Directly Purchased Goods and Services of the Oil and Gas Producers, 2002

Activity	Directly Hired Labour (%)	Directly Purchased Goods and Services (%)
Drilling	27%	40%
Production and Operation	28%	18%
Facility Construction	28%	37%
Other *	16%	5%
Total	100%	100%

* Includes land acquisition and rentals, geological and geophysical services etc.

Figure 10 shows that of the total expenditure incurred in 2002 by the oil and gas producers on directly hired labour, 30% was for labour supplied from within the province, while 70% of expenditures were for labour sourced from outside the province. Similarly, 88% of the goods and services sourced directly by producers in 2002 were supplied from outside the province.

Figure 10. Jurisdictional Shares of Directly Hired Labour and Purchased Goods Sourced by Oil and Gas Producers, 2002 (Aggregated)



The expenditure patterns are, in a way, determined by the structure and historical development of the hydrocarbon resources in the Western Canadian Sedimentary Basin (WCSB), as well as traditional producer business operating practices which rely heavily on contracted service and supply companies.

Much of the resource is located in the mature oil and gas producing regions of Alberta with only smaller portions located in Saskatchewan and, more recently, B.C.. Accordingly, the "hub" of oil and gas industry is located in Alberta, with most companies headquartered there. Thus, it is only logical for producers to operate out of Alberta and source a significant portion of the expenditures in Alberta.

3.2.4 Analysis of Service Sector Expenditures

The process of exploring for and producing oil and gas resources involves hundreds of different skills, and a diverse range of large and small companies that provide these skills. The larger organizations such as drilling companies, well servicing and testing companies, large environmental firms, equipment suppliers etc. are normally located in larger commercial centres mostly in Alberta. The smaller service companies (construction, contract operations, etc.) and supply companies are located in smaller communities throughout the Western Canadian Sedimentary Basin.

Oil and gas service sector companies and equipment suppliers are principally headquartered in Alberta or Texas. A significant portion of producer capital expenditures are expended on sourcing these service companies to provide the multitude of services required to find, produce and transport oil and gas to markets.

When a service company is hired to drill a well or shoot a seismic line, a large portion of their fees will be allocated to the costs of permanent staff, equipment and overhead. The temporary field staff required to conduct seismic or drilling operations, which may be hired locally, is often project specific, seasonal, and mobile. In Canada, exploration service providers will typically staff-up for the winter drilling season, relying on a mobile workforce that can travel to where the work may be. Services and supplies required to support these operations (pipe, equipment, bits, drilling muds, etc.) will normally be distributed from a centralized location (typically Alberta) to specific areas where drilling or exploration programs are being undertaken. Drilling and seismic companies purchase land-clearing services locally while other services are procured primarily outside of B.C.

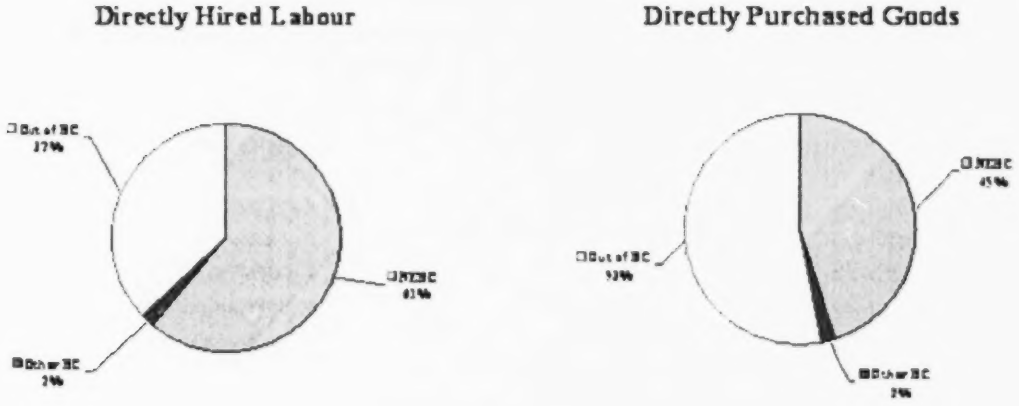
Table 12. Analysis of Total Expenditures for Service and Supply Companies, 2002

Service and Supply Companies, Average Expenditure Share (%)	
Labour	51%
Purchased Goods and Services	49%
Total	100%

Table 12 illustrates that expenditures by service and supply companies are almost equally distributed between labour and goods and services. Labour, as indicated above, includes all the office personnel, drilling, service and seismic crews, land clearing personnel, surveyors, truckers etc. Goods and services include such things as equipment and machinery, supplies for repairs, machine parts, office supplies etc.

Jurisdictional shares for the labour and goods and service expenditures for service and supply companies are presented in Figure 11.

Figure 11. Jurisdictional Shares for Labour and Good and Service Expenditures of Service and Supply Companies (2002) (Aggregated)



As illustrated, more than 60% of the total labour expenditure by service and supply companies occurs within the province (61% from Northeast B.C. and 2% from other parts of B.C.). The remaining 37% of expenditures occur outside of B.C. Of the total expenditures for goods and services, 47% is incurred within the province (45% in Northeast B.C. and 2% in other parts of the province), and the remainder is spent outside the province.

3.3 Summary

- Overall the oil and gas producers spend only 15% of their expenditures on directly hired labour. Directly purchased goods represent 21% of expenditures and the majority, 61%, of expenditures are on purchased services through third-party service and supply companies.

- The service and supply companies on the other hand incur approximately 52% of their expenditures on labour. The remainder is spent on goods and services.

- Together the oil and gas industry spends approximately 45% of its expenditures on labour and 55% on goods and services.

- Of the total labour expenditures, approximately 50% are sourced in B.C. Note that this includes all personnel working in B.C. irrespective of their actual residence for tax purposes.

- Of the total expenditures on goods and services, approximately 30% of expenditures are made in B.C. The rest is sourced outside the province. Again, the expenditures sourced in B.C. include goods purchased from local vendors, irrespective of whether these goods are manufactured in the province.

- On an aggregate level, 40% of the expenditures in the oil and gas industry are sourced within B.C. The remainder are sourced outside the province.

The oil and gas industry is in a relatively early stage of development – there is a considerable amount of exploration and production activity requiring investment in goods, services and labour typically sourced from companies located in Alberta or outside Canada. Over time, the industry will mature and more permanent local infrastructure and jobs will likely be created. Producers and service and supply companies typically hire locally if possible. As educational institutions contribute to increasing skills in the local labour force, resident participation in oil and gas jobs will increase. Even at this early stage of industry development, the significance to the local economy cannot be understated.

3.4 Next Steps

This study is a unique undertaking. The study establishes the baseline importance of the oil and gas industry in B.C., and examines expenditure patterns across industry sectors. However, as it is the first study of its kind to be undertaken for British Columbia, it has stimulated some discussion of further work that could be undertaken.

Follow-up Survey and Analysis: The primary objective of the survey undertaken in this study was to establish the baseline for oil and gas sector expenditures. As such data for 2002 and five years prior were collected. Activity in 2003 increased tremendously, and it is expected that this trend may continue for some years to come. This higher activity may have been created in response to the recent initiatives undertaken by the government. A second survey of the sector activity in 2005 or 2006 may be useful to identify the industry response to such initiatives including changes to expenditure patterns and jurisdictional sourcing, and overall level of economic activity.

Enhancements to the Oil and Gas Model: The oil and gas model created for this study is based on aggregate Northeast regional data. It may be useful to apply this model to distinct geographical zones within B.C., or to distinct projects to evaluate the effects of industry activity.

Enhancements to Base Data for the Northeast Region: At present much of the data for the Northeast are estimated from provincial figures. Additional research is needed to provide greater detail and accuracy for regional information for labour and expenditure sourcing.

Appendix 1: Map of Northeast Region of British Columbia

Appendix 2: Macroeconomic Glossary

Value added: the increase in the value of a product when factors of production are used at each stage in the production process / The value of the labor and capital services that take place at a particular stage of the production process / The value the sector under analysis adds to inputs from other sectors through labour and capital services.

Gross Domestic Product (GDP): unduplicated value of production that originates within the boundaries of British Columbia regardless of the ownership of the factors of production. The sum of GDP across all industries provides an estimate of the total value of production in the economy. GDP can be valued either at factor cost or at market prices. Valuation at factor cost represents factors of production. GDP is often referred to as a 'value added' measure of production since it represents the value added to the purchased units by the factors of production, labour and capital, that are owned by the establishments in the industry. The valuation is expressed in terms of the expense of the producer, rather than the cost to the purchaser. It excludes all indirect taxes such as sales and excise taxes, customs duties and property taxes; but it includes subsidies paid to the producer by the various levels of government. To derive a measure of unduplicated production for each industry and intermediate commodity inputs that are consumed by that industry must be deducted from its gross output. For this reason, GDP or value added may also be referred to as the 'net output' of an industry.

Real GDP: value of Gross Domestic Product (GDP) in constant prices / A measure of the quantity of the goods and services that can be bought with the income of all the individuals in the economy in a year. It is measured as the value of the goods and services produced in a year when output is valued in base-year prices. In this study, macroeconomic indicators are expressed in dollars of 1997 (base-year: 1997).

Input-Output (I-O) model: an I-O model is a representation of the flows of economic activity between sectors within a region. These models capture what each business or sector must provide from every other sector in order to produce a dollar's worth of goods and services.

Direct impacts: changes in economic activity during the first round of spending. For the oil and gas industry, this involves the impact on the oil and gas extraction industry and closely related industries (services to mining, pipeline transportation, etc.).

Indirect impacts: changes in sales, income, employment, etc. within the region in backward-linked industries supplying goods and services to the oil and gas extraction industry and the increased sales within the region from household spending of the income earned in the oil and gas extraction industry and supporting industries.

Total impact: sum of direct and indirect impacts.

Labour force: civilian non-institutional population 15 years of age and over who, during the survey reference week (Labour Force Survey), were employed or unemployed.

Employment: employed persons are those who, during the reference week (Labour Force Survey) did any work for pay or profit, or had a job and were absent from work.

Unemployment: unemployed personas are those who, during the reference week (Labour Force Survey): (a) were on temporary layoff with an expectation of recall and were available for work, or (b) were without work, had actively looked for work in the past four weeks, and were available for work, or (c) had a new job to start within four weeks from reference week, and were available for work.

Not in the labour force: persons not in the labour force are those who, during the reference week (Labour Force Survey), were unwilling or unable to offer or supply labour services under the conditions existing in their labour markets, that is, they were neither employed not unemployed.

Percentage points: percentage points are frequently used to express the difference between two rates. For example: if unemployment rate was 6% in 2003 and it increased to 7.5% in 2004, this is usually referred as "an increase in 1.5 percentage points in unemployment". In the context of this study, a negative "contribution" of the industry to the unemployment rate of 1.5 percentage points, means that the actual unemployment rate is 1.5 percentage points lower with the oil and gas industry in operations, than what it would be without the industry activity. For example, if the unemployment rate without the industry is 8% and the negative "contribution" of the industry is 1.5 percentage points, then the unemployment rate with the industry in operation is 6.5% (8% - 1.5 percentage points = 6.5%).